ON ESTIMATING THE GROWTH TERM FOR USE IN THE DISCOUNTED CASH FLOW MODEL OF DETERMINING THE COST OF EQUITY: FORECASTS BY HISTORICAL METHODS VERSUS SECURITY ANALYSTS' FORECASTS

By

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The cost of capital is of critical importance in almost all financial and economic decision making. Nowhere is that importance more observable than in the process of setting prices for regulated public utilities. Over the past twenty years the discounted cash flow (DCF) model of estimating the cost of equity capital has become the most popular method for ascertaining the cost of capital for regulated public utilities. However, to implement the DCF model it is necessary to estimate the long-term growth rate of cash flows.

In this study, several methods of estimating the growth term are examined. This is done by comparing the statistical properties of estimators derived from historical time series

accounting data with estimators taken from security analysts' forecasts. Security analysts' forecasts are taken from the Institutional Brokers Estimate System (IBES) data base and represent the consensus view of a number of professional security analysts. In addition to direct examination of growth estimators for regulated utility companies, the study also examines a large cross section of non-regulated industrial firms. Historically based and security analysts' forecasts are contrasted on measures of forecast accuracy, systematic biases, and strength of relationships to stock price earnings ratios.

The study's findings indicate that the consensus of security analysts' forecasts is the most reliable estimator of long-term growth for utility companies. For most other industrial sectors, the consensus of security analysts' forecasts is generally equivalent in desirable estimator properties to historically based growth estimators. The study also demonstrates that estimators of growth taken from security analysts' forecasts are more informationally efficient than growth estimators based solely on historical time series data.

CHAPTER ONE

EARNINGS REGULATION, THE DISCOUNTED CASH FLOW METHOD, AND METHODS OF GROWTH ESTIMATION

1.1 Introduction

An explicit knowledge of the cost of capital is of critical importance in many economic decisions. Capital budgeting choices require estimates of the cost of capital as hurdle rates or cut-off points for screening investment opportunities. The valuation of closely held firms with untraded stock, or the valuation of divisions or projects within firms that have traded stock will normally call for an estimate of the cost of capital. Nowhere, however, does the determination of the cost of capital receive more attention, more scrutiny, and more debate than in the process of regulating the prices and earnings of public utility companies. The reasons for such close examination are straightforward. In 1986, for example, the total invested capital of the major domestic electric, gas, and telephone utilities was about \$593 billion.[1] A change in the cost of capital that averaged only one percentage point across this total investment would have changed the

[1]Based on the total debt, preferred stock, and common equity outstanding for all firms with Standard Industrial Codes 4811 and 4911 through 4932.

annual revenue requirements, that is, the total anticipated cost of the aggregate consumption of these regulated goods and services, by almost $12 billion. That is equivalent to an annual per capita redistribution of wealth of about $60. An event of such immediate and immense economic impact on society must obviously be examined carefully.

Yet the determination of the cost of capital, including consideration of how and when it does change, is not an exact science. The methods and procedures that are used to evaluate the cost of capital are evolving dynamically. At any point in time, the methods are neither unanimously accepted nor subject to universally consistent application. In many respects, regulatory proceedings have served for many years as the field testing laboratories of financial economists in the development of cost of capital methods. Almost as soon as a new concept or theory is introduced in the academic literature, somewhere there will be an expert financial witness appearing before a regulatory body attempting to introduce that concept in estimating the utility's cost of capital. And because the stakes are high and the regulatory process in the United States has become increasingly adversarial, these innovations rarely go unchallenged. In fact, as Harrington (1979) has indicated, as was the case of the introduction of the Capital Asset Pricing Model (CAPM) to the regulatory

process, the ensuing debate provides valuable feedback to the academic community at large, stimulating vast amounts of empirical and theoretical research.

It is within this regulatory environment that questions about the appropriate estimate of growth for use in determining the discounted cash flow cost of equity capital have received significant attention, especially within the recent several years, when a method of producing growth estimates using the consensus of security analysts' forecasts emerged as a direct challenge to the more traditional estimating technique that relies on the extrapolation of historical time series data.

The purpose of this chapter is to briefly describe that regulatory environment, discuss the importance of the cost of capital to the determination of regulated prices, and set the stage for the specific analyses of the later chapters. In Section 1.2, an introduction to the underlying economic principles of price and earnings regulation is presented. This is followed in Section 1.3 by a simple model that explains how the cost of capital is used in rate setting procedures that are followed in almost all regulatory jurisdictions. Next, Section 1.4 sets out the economic and legal standards that qualify a fair rate of return. In Sections 1.5 and 1.6 the basic concepts of the discounted cash flow model are reviewed and the general methods that are used for growth estimation are introduced.

1.2 The Economic Principles of Regulation

The justification for regulatory control and intervention arises out of an alleged inability of the marketplace to deal with particular structural problems. Kaysen and Turner (1959) suggest that regulation or exemption from competition may be appropriate when one or more of three situations are found within an industry:

1. Situations in which competition, as a practical matter, cannot exist or survive for long, and in which, therefore, an unregulated market will not produce competitive results.

2. Situations in which active competition exists, but where, because of imperfections in the market, competition does not produce one or more competitive results.

3. Situations in which competition exists, or could exist, and has produced or may be expected to produce competitive results, but where in light of other policy considerations competitive results are unsatisfactory in one or more aspects.

For a public utility, the first situation is the most traditional and persistent rationale for regulation of the firm's prices and profits. For these firms, the technology of the industry creates the existence of a "natural monopoly." In other words, it is claimed for many basic types of services, that the market cannot efficiently support more than one firm. For example, up to a point, electricity producers find it progressively cheaper to supply extra units of electricity. Similarly, local telephone companies have "economies of scale" so that unit costs would rise significantly if more than

one telephone company attempted to supply service in a particular area. Thus, the traditional rationale has been that it is more efficient to grant one firm a monopoly for a service territory. And, in order to protect the consuming public from abuses of that monopoly, the firm's prices and earnings become subject to government regulation.

This traditional view holds that in the case of market failure due to the existence of economies of scale and natural monopoly, the aim of price and earnings regulation is to emulate the results that exist in a perfectly competitive market.[2] That is, where in a perfectly competitive market, firms would expand output up to the point where price equals marginal cost, an unregulated monopolist, on the other hand, curtails production in order to raise prices. While higher price means lower demand, the monopolist will willingly forego quantity sales to the extent that lost revenues are compensated for by higher revenues on the units he does

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[2]A more recent view, associated primarily with Baumol, Panzar, and Willig (1986), Bailey (1971), and Faulhaber (1975), holds that the potential for competition may be sufficient to produce competitive results. That is, unless a market is truly characterized by subadditive production costs, the possibility that a competing firm may engage in "hit and run" entry and exit is sufficient to cause the incumbent firm to price its goods in a competitive manner. In that event, exogenous regulatory intervention is not required. When barriers to entry are low, these markets are said to be contestable. This view underlies much of the movement towards deregulation of the interexhange telecommunications business.

sell at the higher price. The result is waste; consumers end up buying more of cheaper but less preferred products, even though it costs society less in real terms to produce more of the monopolized product. Thus, where economies of scale create a natural monopoly, the regulator will attempt to set regulated monopoly prices (rates) near the prices that would obtain in a competitive market, and thereby induce the monopolist to expand output to the socially desired level and to reduce the amount of inefficient consumption substitution by buyers.

The price that is set by the regulator, however, is generally not equivalent to the marginal costs of production as would be required in the standard model of perfect competition. As Faulhaber (1975) and more recently, Baumol (1986) have pointed out, economies of scale preclude the financial viability of a rule requiring equality between prices and marginal costs. Prices which cover only marginal costs do not in general contribute to covering any of the fixed costs of production. This is so, because economies of scale often occur in the presence of substantial fixed investment and strict adherence to the price-equals-marginal-cost standard would not allow the owners of the regulated firm to recover these fixed costs. As a consequence, regulators have most often adopted a policy that equates price with the average total unit cost of production (that includes depreciation

of the fixed plant investment) plus a return on the investment.

It is that process and procedures of how regulated prices are determined that are the subjects of Section 1.3. And as will be shown, one of the primary elements in setting prices is the determination of the return to be allowed to the equity investors of the firm. In concept, the regulator can achieve at least one of the outcomes of perfect competition of eliminating monopoly profits by allowing a fair return on the equity investment that is equivalent to the marginal cost of equity capital.

1.3 The Cost of Common Equity and Its Use In A Common Regulatory Procedure for Establishing Prices

The most common system of establishing prices for regulated monopolies is known as cost-of-service ratemaking. It is currently being used to set prices for electricity generation, transmission, and distribution companies, local and interexchange telephone companies, gas distribution and transmission companies, water and sewage companies, and until recently was used as a price-setting mechanism in such industries as airline transportation, bus and livery transportation, and trucking and cartage.

Cost-of-service ratemaking is essentially a two step process. First, the total operating costs (OC) of producing a given amount of output are determined. These

operating costs include, where appropriate, direct costs of production such as fuel, labor salaries and fringes, supervision, and indirect costs such as maintenance, general administration, marketing, finance and accounting, and other overheads, as well as taxes. Added to the basic operating costs of production are the capital costs of depreciation (D) which represents the periodic recovery of the fixed investment, and a reasonable level of earnings (E) that allows the firm to pay its debt interest expense and afford its equity investors a compensatory rate of return for putting their money at risk in the productive endeavors of the firm. The total of operating costs of service and capital costs of service is called the revenue requirement (RR),

$$RR = OC + D + E,$$

which is equivalent to the amount of money the firm needs to collect from its customers to pay its expenses of production, recover its fixed investment and provide its investors with a fair rate of return.

The second step in cost-of-service ratemaking is to establish a unit price (P) for the firm's goods or services by dividing the total revenue requirement by the anticipated number of output units (Q) that will be sold,

$$P = RR / Q .$$

This has the effect of setting the unit price equal to the average total unit cost of production.[3]

Through the investigation of the utility's cost of service, investment, and management, and ultimately through the setting of prices, regulators seek to ensure that certain societal objectives are achieved. Breyer (1982) has noted that while the precise objectives of cost-of-service ratemaking vary from jurisdiction to jurisdiction, regulators would generally agree that such a system should ordinarily seek to (1) prevent excess profits, (2) hold prices down to costs, (3) avoid economic allocative waste by minimizing shortages and surpluses, (4) eliminate inefficient production methods, and (5) assure administrative ease. The first four objectives are generally believed to occur in a competitive marketplace, thus it is often stated that the ultimate goal of earnings regulation through the mechanism of cost-of-service ratemaking is to replicate a competitive market.

Although simple in concept, the actual application of cost-of-service ratemaking can become burdensomely

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[3]This description abstracts intentionally from the difficulties encountered in establishing prices for multiproduct or multi-customer class firms. For firms offering several different regulated goods or services, or whose total output is taken by customers with highly distinct demand characteristics, it is necessary to allocate the costs of services among those goods and services or customer classes. That cost allocation process can be extremely complex and controversial. However, the basic steps of cost of service ratemaking remain unchanged.

complex. Prices are generally being set for consumption that will occur in the next and several immediate future periods. Thus, the measurement of the underlying costs of production should, in theory, reflect the costs that are expected to be incurred during those future periods. Similarly, the output quantities that are anticipated to be sold must also be forecast. Regulators seek to establish a base time period, called the test year, from which reasonable forecasts of costs and output can be made. The test year may be an actual historical period of time, perhaps the most recent twelve months preceding the filing of a request for a rate change. When historical test years are used, pro forma adjustments to reported accounting data are often made to make the test year results as representative as possible of the expected economic environment that will apply when the new rates go into effect. As the general economy has become more volatile, with rapidly changing inflationary expectations and the dramatic impacts of uncertain fuel and capital costs, both the nature and magnitude of these adjustments have become more important and contentious issues during rate case proceedings. In other regulatory jurisdictions, the test year may be a hypothetical future twelve-month period. In that case, the costs of service are based on budgets and projections. When a future test year is used, it is often the assumptions underlying the forecasted amounts that come under critical review.

Other areas of debate include the accounting conventions that are used to record expenses and revenues. In many instances, there are legitimate, professional disagreements over deferring certain expenses until future periods or recognizing them as costs of service during the test year. In some extreme circumstances, costs may be deemed imprudent or unnecessary, and totally or partially disallowed from inclusion in the cost of service. For example, management salaries may be deemed excessive and therefore only an amount of salaries acceptable to the regulator would be allowed in the cost of service. Or, the regulator may feel it is inappropriate for the firm to advertise its goods because it is a monopoly, and therefore disallow entirely marketing expenses.

Concurrently with the estimation of the operating costs of service, the amount of assets required to produce the expected output must also be ascertained. These assets, termed the rate base (RB), represent the dollar investment in land, fixed plant and equipment, material and supply inventories, fuel stock, and other productive assets. In addition, an allowance for the working capital used to provide for timing difference between the receipt and disbursement of cash is often included in the rate base. In this discussion, it is assumed that the rate base is financed in total by the capital supplied by investors in the forms of debt (D), preferred stock equity (PS), and common equity (CE),

$$RB = D + PS + CE.$$

This investment must generate enough earnings to pay interest on debt, provide for dividends on preferred stock, and compensate the equity investors for putting their money at risk.[4] The return that is required is called the cost of capital. Within the framework of cost-of-service regulation, the cost of capital, or the overall rate of return (ROR), is measured as the weighted sum of the cost of existing debt (K_d), the cost of existing preferred stock (K_p), and a fair rate of return on the common equity capital (ROE). The weights are determined by the relative proportions of the sources of capital used to finance the rate base,

$$ROR = K_d \times (D/RB) + K_p \times (PS/RB) + ROE \times (CE/RB).$$ [5]

The actual dollar earnings requirement (E) is then computed by multiplying the rate of return time the rate base,

$$E = ROR \times RB$$

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[4]There are other sources of capital that can finance the rate base including the accumulated cash inflows provided by deferred income taxes, customer deposits, and investment tax credits. With minor modification, the current discussion can be extended to accommodate those types of capital.

[5]It may be the case that the total dollar value of the rate base is less than or greater than the sum of investor-supplied capital. However, it is generally implicit in rate case proceedings to treat the rate base as being equal to total capital (subject to adjustments for so-called zero cost capital). This means that the capital structure percentages used in computing the overall cost of capital are the same whether they are normalized to rate base or to total capital.

and the dollar revenue requirement is equivalent to the sum of the individual cost components,

$$RR = OC + D + (RB \times ROR),$$

and finally after substituting in the complete cost of capital expression, the revenue requirement can be stated as a function of the cost of capital through

$$RR = OC + D + RB \times [K_d \times (D/RB) + K_p \times (PS/RB) + ROE \times (CE/RB)]..$$

In assessing the importance of the cost of capital on the ultimate revenue requirement, it should be noted that many regulated utilities use highly capital-intensive production technologies. These firms often invest \$2 to \$3 dollars in rate base assets in order to produce output that can be sold for \$1 of revenue. It is not at all unusual to find that that the required earnings on the investment of these capital intensive regulated firms can constitute 20 to 25 percent of the total revenue requirement. Thus, the linkage between the determination of a fair rate of return and the revenue requirements and ultimately the prices paid by consumers is quite direct when cost-of-service ratemaking is employed.

1.4 Financial and Legal Standards of a Fair Rate of Return

Generally, the costs of debt (K_d) and of preferred stock (K_p) are measured as the embedded or average costs of the currently outstanding debt and preferred. These embedded cost rates can be determined exactly from the

contractual agreements that exist between the company and its debt and preferred stock holders. The fair rate of return (ROE) on common equity capital is not formally contracted. Rather, as with all common equity investments, the return to common equity represents a residual claim on the earnings of the firm that is paid only after all prior claims have been met. However, investors will not make an equity investment unless they anticipate that this residual return will, over time, offer them fair compensation for the risks they bear. It is the province of cost of capital experts to determine the <u>minimum</u> level of return required by investors that will induce them to make a common equity investment in the regulated firm. To offer more than the minimum level would generate excess profits for the shareholders and unduly burden the ratepayers. To offer less than the minimum required level would penalize existing investors and have the effect of confiscating their investment.

Gordon (1974) has demonstrated that under certain assumptions about the reactions of regulators to changes in the economic environment, a fair rate of return on equity capital will cause the market value of the firm's common equity to just equal the accounting book value of the equity portion of its rate base investment. In other words, if regulators allow the firm to earn a fair rate of return on its common equity investment that is just equal to the marginal, market cost of equity capital (K_e) of

corresponding risk, the opportunity for excess or monopoly profits will be eliminated. In turn, the market value of the firm's common equity will be equal to the regulatory-determined value of its earnings base, that is, the equity portion of its ratebase.

To see this, let the accounting book value of the equity portion of the ratebase (B) be defined as

$$B = RB \times (CE/RB),$$

then expected annual pool of earnings available for common equity (ignoring the impact of dividend policy and future investment) is given by

$$ROE \times B.$$

Gordon's standard for determining a fair rate of return follows from assuming that the equity investors are purchasing a future stream of earnings with an expected annual value of (ROE x B). The marginal investor will be willing to pay an amount just equal to the present value of this stream of earnings (M), where the present value is determined by discounting the earnings stream at the appropriate risk-adjusted cost of equity capital, K_e. For the sake of simplicity but without loss of generality, if the stream is assumed to be a perpetuity, Gordon's definition of a fair rate of return can be expressed algebraically as

$$M = (ROE \times B) / K_e.$$

That is, the market value is equal to a perpetual stream of earnings of (ROE x B) capitalized at the rate K_e. If

ROE = K_e, then M = B, and all monopoly profits will have been eliminated. Thus, the goal of regulators in setting utility prices should be to determine the marginal, market required cost of equity capital, and to utilize that value as a fair rate of return on the book value of the common equity portion of the rate base investment. Gordon's work provided direct linkage between the economic concepts of opportunity cost and the estimation of a fair rate of return on common equity that was appropriate for ratemaking purposes. As such, his approach was largely responsible for shifting the focus of regulatory attention away from book accounting results and toward the capital markets for determining the cost of equity.

Although Gordon's conceptualization of the regulatory problem provided economic guidance for measuring and estimating the cost of equity capital, the controlling regulatory standards for a fair rate of return are legal principles established in two Supreme Court decisions, Bluefield Water Works & Improvement Company v. Public Service Commission of West Virgina (262 U.S. 679, 1923) and Federal Power Commission v. Hope Natural Gas Company (320 U.S. 391, 1944). In Bluefield, the court determined the standard against which just and reasonable rates (prices) are measured:

> A public utility is entitled to such rates as will permit it to earn a return on the value of property which it employs for the convenience of the public equal to that generally being made at the same time and in the same general part of the country on investments in other business

> undertakings which are attended by corresponding risks and uncertainties.... The return should be reasonable, sufficient to assure confidence in the financial soundness of the utility, and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise money necessary for the proper discharge of its public duties. (Page 116)

In Hope, the court expanded the guidelines to be used in assessing the reasonableness of the allowed rate of return. The court again reemphasized the comparable risk nature of the return and made special note that the costs of service include a fair amount of earnings,

> The rate-making process under the act, i.e., the fixing of "just and reasonable" rates, involves a balancing of the investor and the consumer interests. Thus we stated in the Natural Gas Pipeline Co. case that "regulation does not insure that the business shall produce net revenues." 315 U.S. p. 590. But such considerations aside, the investor interest has a legitimate concern with the financial integrity of the company whose rates are being regulated. From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on the debt and dividends on the stock.... By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and attract capital. (Page 25)

Morin (1984) has termed both the economic and legal standards of a fair rate of return transparent and stated that the real difficulty in determining a fair rate of return is the implementation of the concepts. That is, despite the obvious correspondence between the

precepts of <u>Hope</u> and the financial concept of the cost of capital, public utility statutes give no detailed formula or prescription for what constitutes a "just and reasonable" rate of return on equity. The applicable legal standards permit public utility commissions to choose among a variety of analytical techniques and procedures in setting the allowed rate of return on equity. Kolbe, Read and Hall (1984) reviewed the hearing transcripts and testimonies of a number of rate cases and found that five general cost of capital methods have been commonly used to implement the concept of determining a fair rate of return on common equity capital[6]. They are in order of the frequency of their total historical use: (1) Comparable Earnings, (2) Discounted Cash Flow (DCF), (3) Capital Asset Pricing Model (CAPM), (4) Risk Premium (or Risk Positioning), and (5) Market-to-Book Ratio. The comparable earnings method was the most prevalent method of establishing a rate of return until the mid 1970s. According to Kolbe, Read and Hall, at the time of the publication of their study, the Discounted Cash Flow

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[6]Morin also identifies the Arbitrage Pricing Theory (APT) as a method of estimating the cost of equity capital. However, a review of regulatory testimonies indicates that to date it has received extremely limited use. Other methods that have received limited use include econometric models for the determinants of risk and/or the cost of equity and financial integrity models that condition the required return on necessary levels of cash flow or interest coverage.

method had become the predominant methodology in terms of current usage.[7]

Although the choice of method is extremely important, it should not be forgotten that the ultimate legal standard for a fair rate of return is the so-called "end result" test. In effect, while the rate of return that is used to set rates must be compensatory and must not confiscate the wealth of investors it must also be equitable to consumers. Striking a balance between the competing interests of investors and consumers is a political not an economic decision. However, financial economics may be able to improve the estimation of the cost of capital, so that ultimate judgements of fairness may be predicated upon stronger evidentiary support.

1.5 The Discounted Cash Flow Method for Estimating the Cost of Equity

The classical value theory of Irving Fisher (1907) and J.B. Williams (1938/1956) holds that value of an asset is determined by its earnings power or its ability to generate future cash flows. That theory states the fundamental value of an asset is the discounted sum of all future cash flows that are expected to be received by the owner of that asset. The Discounted Cash Flow (DCF) model

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[7]A cursory review of rate case testimonies and generic rate of return proceedings after the 1984 publication of the Kolbe, Read and Hall study tends to further strengthen the view that the Discounted Cash Flow method continues to be the most often used cost of capital methodology.

of security valuation has emerged as the direct application of that classical theory.

The most general form of the DCF model is developed by first noting that for the holder of common stock, the expected cash flows come in the form of dividends and changes in the price of the stock. Letting D_t represent the dividend the stockholder expects to receive in Year t, P_t represent the price of the stock at the end of Year t, and K_e be the required rate of return on the stock. If the shareholder anticipates receiving dividends for n periods and then selling the stock at the end of nth period for P_n, the present value of the stock can be determined from

$$P_0 = \frac{D_1}{(1+K_e)^1} + \frac{D_2}{(1+K_e)^2} + \frac{D_3}{(1+K_e)^3} + \ . \ . \ . + \frac{(D_n + P_n)}{(1+K_e)^n} .$$

In this equation, the pattern of dividends is unspecified through time. That is, dividends may increase, decrease, become zero or quite large and the model may still be used to assess the value of the stock. By imposing structural assumptions upon the time path of dividends and earnings changes, a simplified, easily solved version of the model may be developed. Gordon (1962) has shown that if (1) dividends are expected to grow at a constant rate, g, over an infinite number of periods, (2) g is less than K_e, and the firm either (3a) issues no new common shares or (3b) realizes no gain or

loss when new shares are issued, the model reduces to

$$P_0 = \frac{D_1}{K_e - g} .$$

This is known as the Gordon or constant growth version of the DCF method. By rearranging the terms of the equation, the constant growth model may be solved for the required rate of return on the stock, K_e,

$$K_e = \frac{D_1}{P_0} + g .$$

While more complex and less restrictive versions of the DCF are sometimes employed, the above equation forms the basis for the most commonly used DCF technique for estimating the cost of equity capital. If it is further assumed that the observed market price of the stock is in equilibrium and that reasonable estimates of the anticipated next period dividend and long-term growth rate can be made, then it is a straightforward computation to arrive at an estimate of the required rate of return on common equity for the firm in question.

The commonsense logic of the model is that the equilibrium, required rate of return on the stock is the sum of expected dividend yield and expected capital appreciation or growth. Moreover, the model posseses algebraic simplicity and is easily explained. Most likely, it is these properties that have made the

constant growth DCF model the currently most often used method of determining the cost of equity capital.[8]

1.6 Commonly Used Growth Estimators

While simple in form, the DCF model does have a major implementation problem: in order to use DCF procedures to estimate K_e, an independent estimate of g must first be made and then used as an input to the equation. That is, in actual application, while not always generally agreed upon, the measurement of the stock price and anticipated dividend pose less problems than the estimation of the long run growth rate. According to Morin (1984),

> The principal difficulty is calculating the required return by the DCF approach is in ascertaining the growth rate which investors are currently expecting. While there is no infallible method in assessing what the growth rate is precisely, an explicit assumption about its magnitude cannot be avoided. Estimate of the growth component is the most difficult and controversial step in implementing DCF since it is a quantity which lies buried in the minds of investors. (Page 123)

In their review of rate case testimonies, Kolbe, Read, and Hall (1984) found that the popular methods of growth estimation may be placed in three general categories:

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[8]In recently completed generic rate of return dockets for the industries that they regulate, both the Federal Energy Regulatory Commission and the Federal Communications Commission specifically adopted the constant growth DCF model as the primary method for determining the cost of equity capital. In some state jurisdictions, the DCF method is the only method that receives recognition for the determination of the cost of equity.

> 1. Use of historical growth rate of dividends over some past period, often five or ten years. Sometimes past growth in earnings or book value per share is used as a proxy for dividend growth, because dividends are changed by firms in discrete jumps, so that their estimated growth rate can change noticeably with the exact starting and ending points of the data series.
>
> 2. Use of forecasts of growth rates published by investment services. These forecasts are assumed to be representative of the expectations of investors.
>
> 3. Use of the "sustainable" (also called "retention" or "plowback") growth rate, measured as the rate of return on book equity, BROE, times the proportion of earnings that is retained within the firm, b, instead of being paid out as dividends. That is, an estimate of growth is equal to (b x BROE). This approach recognizes that if the firm is earning exactly its cost of capital, future growth in dividends for existing equity can only come if part of the overall return to investors is plowed back instead of being paid out. (Page 55)

In the discussion below, some characteristics of each of the first two of these growth estimator methods are described.[9]

First, however, it is useful to list some reasonable standards for assessing the quality of growth rate estimators. These standards allow, essentially, a

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[9]The third approach is less of a competing method than a computational methodology. The sustainable growth approach may be implemented using either historical or forecast data and will not be treated in this study as a separate and distinct forecasting methodology. If prior period retention ratios and book rates of return are used, the sustainable growth method is simply a variation on the trending of historical data. If security analysts forecasts of retention and BROE are used, the b x BROE approach is simply a variation of using directly analysts' forecasts of growth. In fact, in Chapter 6 it is shown that the b x BROE approach may form the basis of many security analysts forecasts.

formulation of testable hypotheses which will be examined empirically in later chapters. At this stage of the study the standards provide a basis for logical and a priori reasoning about the relative strengths and weaknesses of the competing estimator methods. To evaluate the appropriateness of growth estimating methods, Brigham, Vinson, and Shome (1983) identified four desirable properties of a growth rate estimator,

> 1. Estimates should be unbiased. Valid procedures should, on average, produce estimates that are neither systematically higher nor lower than the "true" value of the variable of interest. Thus, if a growth rate estimating technique can be shown to produce estimates that tend to be too high or too low, then that technique fails a critical test.
>
> 2. Estimates should be efficient. A valid estimating method should utilize all relevant information; that is, the estimate should not disregard information. If a method of estimating growth fails to utilize data which exists and which can logically be expected to affect growth, then the method fails this test.
>
> 3. Estimates should be consistent. A method should produce growth estimates that are not highly sensitive to the selection of a particular sample of data used to estimate the value. Thus, if a method produces radically different estimates of the growth rate for a given company in a given time period due to seemingly slight changes in input data, then the method fails the consistency test.
>
> 4. Estimates should be reflective of the opinions of market participants. This point is critical in a DCF cost of capital analysis, because it is the representative investor's opinion that determines a company's stock price and its cost of capital. (Page 2)

1.6.1 Growth Estimates Derived From Historical Accounting Data

Cost of capital analysts have often based their historical computations on earnings per share, dividends per share and book value per share. While DCF theory states clearly that it is the expected future cash flows in the form of dividends that constitute value, a case can be made for using the other quantities as well.

First, the ability to pay dividends stems from a company's ability to generate earnings, and therefore, growth in earnings per share can be expected to influence the market's dividend growth expectations. A major disadvantage of using directly dividend growth is the discretionary nature of the firm's dividend policy. That is, historical dividend growth may be biased because of short run changes in the payout rate of the firm. Over the longer run, growth in earnings per share may set the pace for future dividend growth and thus, the expectation of earnings growth may be more representative of future dividend growth. A drawback to using a historical time series of earnings per share to derive expected growth is the relative volatility of earnings. When earnings per share become negative or very small, historically based growth estimates may become highly distorted or computationally infeasible. In addition, firms are known to "window dress" earnings per share through accounting machinations; thus reported earnings per share may not be

reflective of the expected or the ongoing level of earnings.

The use of historical growth in book value per share as a proxy for the expected dividend growth of a regulated utility may be justified under certain conditions. Book value is a principal determinant of earnings for utilities in original cost rate base jurisdictions. Because earnings per share are the product of the earned rate of return and book value per share, the historical growth in book value per share may provide an indication of the growth of earnings per share. In turn, as noted above, growth in earnings per share may pace the growth in dividends per share. However, two assumptions are crucial to the usefulness of book value per share growth, (1) the future earned rate of return must be expected to remain stable, and (2) the market to book ratio must remain stable about unity. The later assumption is especially important because book value per share will increase or decrease with the issuance of new shares when the market to book ratio is different from one. The type of growth that is attributable to book value accretion or dilution is generally transient and serves to produce biased proxies for long-term expected growth.

After selecting an historical series of data, the time period over which growth is to be measured must be established. In concept, the period should be recent enough so that it can be claimed to be representative of

current economic conditions. At the same time the data period should also be long enough to avoid short-term influences. Selection of a time period depends largely on judgement, but customarily historical based estimates rely on the most recent five to ten years of data, although some analysts have used as long as a twenty-year time series, and others as short a period as the most recent single year rate of growth.

The analyst must also choose a computational form for extracting the growth rate from the raw accounting data. Numerous methods have been employed including the root of the first ratios of the beginning and ending values (geometric averaging), least squares trend fitting, moving averages, weighted averages, centered averages, and simple averages. These computational methods are more or less highly sensitive to the choice of beginning and ending values, and are not generally consistent when the data period is changed slightly.[10] More sophisticated computational methods such as Box-Jenkins or extrapolation with intervention are not generally used due to the large

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[10]It is an understatement to say that confusion exists among those seeking to compute historical rates of growth. For example, in formulating cost of capital rules that would apply to 1400 firms that provide interstate telecommunications services, the Federal Communications Commission recently proposed the use of the slope coefficient derived from the simple linear regression of quarterly dividends per share on a time index over a period of eight fiscal quarters. When it was pointed out, that the resulting slope coefficient in no way approximated for annual dividend growth, the FCC quickly modified its proposal.

data input requirements that are necessary to establish the base model.

The choices of data series, computational form, and data period are examined in more detail in Chapter 4. However, in general, it can be said that historical data reflect the economic conditions that prevailed in prior periods. If the economic structure has changed or if there is an anticipation that it may change, the use of historically based growth rates can not reasonably be expected to produce quality estimates of the current growth expectations of investors. It has been said that the naive extrapolation of historical data for determining expected growth is very much like driving a car by only looking in the rear view mirror. While this criticism is certainly valid, the use growth rates derived from historical data series are popular because of the ease of data acquisition and the presumed factual character of the data themselves.

1.6.2 Security Analysts' Growth Forecasts

An alternative to the use of historical data is to base growth estimates on security analysts' forecasts. Most large investment banking firms, some large institutional investors, and many investment research firms employ security analysts who produce forecasts of future earnings and dividends. Often the same analysts produce forecasts of long-term growth in earnings and

dividends, or the implicit growth rate may be extracted from the underlying earnings and dividend forecasts. The analysts who make these forecasts often specialize in particular industries, and they often come to the financial analysis profession with substantial experience from previous employment in the particular industry which they analyze.

At any given time, several different analysts may be making forecasts about the same company. Because it has been recognized by market participants that the composite or consensus of these forecasts might be more informative than any single analyst forecast, information service companies that collect forecasts and publish them in summary form have come into operation. The oldest such service is the Standard and Poor's Earnings Forecaster which provides information on the one year ahead and two year ahead earnings per share forecasts of many security analysts. A different type of service began, almost inadvertently, in 1968. Burton Malkiel, then of Princeton University and John Cragg of the University of British Columbia, in cooperation with the Institute for Quantitative Research in Finance, collected both the short run earnings per share forecasts and the long-term earnings growth forecasts of several investment firms in order to conduct research on the nature and accuracy of those forecasts. This data base and subsequent augmentation served some limited academic research

purposes for several years until its maintenance was taken over by the Wall Street firm of Lynch, Jones and Ryan. Lynch, Jones and Ryan began marketing the consensus (mean) one year ahead and two year ahead earnings per share forecasts in the mid 1970s under the name Institutional Brokers Estimate System (IBES). They expanded the number of companies covered to include almost all of the New York Stock Exchange listed firms and a number of firms on the American and over-the-counter exchanges. They also increased the number of analysts that contributed forecasts to the consensus value. In late 1981, Lynch, Jones and Ryan began systematically collecting the long-term earnings (five or more years ahead) growth forecasts and in January of 1982, the first ongoing, well maintained data base of security analysts' long-term growth forecasts became publicly available.

Lynch, Jones and Ryan intended the data base to provide subscribers with growth estimates that could be used in valuing securities. That is, subscribers were generally known to be using the growth estimates as inputs to the DCF model in computing the expected dividends to be received in future periods, and then discounting that stream of dividends at the cost of capital they felt to be appropriate for the security's risk in order to determine their intrinsic value for the stock. That intrinsic value served as a basis of comparison with market prices in making investment decisions.

Although cost of capital analysts had been using individual security analyst's forecasts of growth for several years, most notably the forecasts of Value Line, many cost of capital analysts were quick to recognize the improvements to be gained through the use of a broad based consensus forecast. Not only was there an immediate improvement in the representation of differing opinions embedded in the consensus, but there was also a gain from using standardized consensus forecasts from an independent source. That is, the availability of the IBES consensus forecasts removed an element of judgement and potential selection bias that had plagued the evidentiary quality of the use of analysts' forecasts up to that point.

While the use of the IBES long-term growth forecast data has spread quickly since their introduction, questions remain about the appropriateness of the use of the reported consensus measure. Morin (1984) has suggested that "one could decide which analysts make the most reliable forecasts and then confine the analysis to those forecasts" (page 56), although he goes on to note that approach may be impractical due to the difficulty of securing the track records of the individual forecast agents. Litzenberger (1985) suggested that only analysts who have been recognized by their investment clients as providing superior information, such as those analysts who rank highly on the Institutional Investor poll, should be included in the consensus computation. Others have

suggested that the median of the individual forecasts be used as the consensus measure as opposed to using the mean forecast because the median is less influenced by outlying and, presumably, less influential opinions about the growth prospects of the stock. Those in opposition to the use of security analysts' forecasts have argued that the analysts or the investment houses they represent are often friendly to the firms whose earnings are being regulated, and would, therefore, bias their growth forecasts upwards if they felt they could influence the outcome of the authorization of the rate of return level. Still others, relying upon anecdotal evidence, dismiss the usefulness of the forecasts because of their poor forecast accuracy.

More of a complaint than a criticism is the observation that the precise forecasting methods used by analysts are not generally known. Because of the proprietary nature of the analysts' services they rarely acknowledge how they actually go about making forecasts. It is reasonable to assume, however, that they often begin with a historically based extrapolation and then supplement that information with their private knowledge of the industry or the company under analysis. This in consistent with some results of Chapter 4, where the correlations of historically based growth rates and analysts' forecasts are shown to be generally positive but not overly large.

Finally, during the initial period of introduction of the IBES forecasts into the regulatory arena, the IBES values have tended to be greater than the growth estimate values derived from historical time series. This condition created a clientele of cost of capital witnesses who opposed the use of IBES values apparently because the security analysts' forecasts generated cost of capital estimates that were higher than the cost of capital estimates produced by historical growth estimates.

CHAPTER TWO

THE THEORETICAL ROLE OF SECURITY ANALYSTS' FORECASTS IN THE FORMATION OF INVESTOR EXPECTATIONS

2.1 Introduction

Most of the existing research that is important to the study of security analysts' forecasts is empirical in nature. This is apparently so because the existence of security analysts, their long-run equilibrium employment, and an obvious demand for their costly services provide sufficient economic justification for scientific observation and analysis without the necessity of establishing a formal theoretical basis. As noted by Stanley, Lewellen, and Schlarbaum (1981),

> The question as to whether there is truly a payoff from devoting resources to producing those [security analysts'] outputs, however, has been addressed on a number of occasions in the literature of finance . . . [and] the reviews to date are decidedly mixed.
>
> Clearly, individual investors are paying for large quantities of this research, either directly through subscriptions to investment advisory services or indirectly in the commissions charged. . . . Thus, it appears as though the product is in demand--which, in a private enterprise economy, is not generally a characteristic thought to be possessed by an item having no value. (Page 1)

This observation, however, is inconsistent with at least the strong form of the hypothesis of capital market efficiency (Fama, 1970) which states that market prices

reflect perfectly and instantaneously all available information. This implies that analysis of individual firms, industries, or the economy cannot contribute to returns, and therefore such analysis, while having a cost, has no payoff. Further, in rational markets characterized by strong-form efficiency, security analysis would cease to exist. When taken to its logical extreme, strong-form efficiency implies that prices are fully revealing of all information, and therefore, investor expectations are endogenously determined, conditional only upon the prices themselves. In other words, information like security analysts' forecasts which comes from an exogenous source other that security prices would play no theoretical role in the formation of investor expectations.

This chapter is concerned with developing theoretical support for the function of security analysts as producers of useful information within an efficient market context. In Section 2.2, the notion of market efficiency is expanded to allow exogenous information such as security analysts' forecasts of growth to potentially impact the formation of investor expectations. In Sections 2.3 and 2.4 models incorporating diversity of opinion and information production are derived that allows specification of the consensus expectation in a way that specifically demonstrates why the expectations of wealthy, well-informed investors may dominate in the determination of equilibrium prices. Section 2.5 develops a theoretical

basis for the observation that diversity in security analysts' forecasts may be positively related to the riskiness of securities. In Section 2.6, simulation analysis using empirical estimates of the relevant parameters is reported in an attempt to quantify the weight of classes of market participants in the formation of the consensus expectation.

2.2 A Model of Market Efficiency and Information Production

Fortunately, for the working security analyst concerned about the long-term viability of her job and for the empirical researcher with significant data to analyze, the strongest form of the efficient markets hypothesis has been generally rejected.

For example, Grossman and Stiglitz (1980), have demonstrated under plausible conditions that even in theory prices cannot reflect perfectly all information when that information is costly to obtain. In keeping with Akerloff (1970), they show that if the price system were fully informative, there would be no differences in expectations (that is expectations would be determined endogenously from prices which are freely observable by all market participants), and if there were no differences in expectations then there would be no trade, and markets would collapse. In other words, an equilibrium would quickly obtain where no one would feel that they could become better off by

trading their endowments, so no trading would take place. As an alternative, Grossman and Stiglitz have constructed an alternative notion of market efficiency that allows for some private information production and some endogeny of information in prices. Competitive market efficiency is viewed as a process instead of a fixed equilibrium, where the force driving prices toward their efficient level is the production of private information. In a sense, their model is an equilibrium degree of disequilibrium: prices only partially reflect the information of investors who choose to become informed, so there may always be incremental gains to acquiring private information. The following presents a stylized version of the Grossman-Stiglitz model.

There are two assets, one safe and one risky. The risky asset has uncertain return, K, which depends on a random variable, u, which can be observed at a cost, and another, unobservable random variable, v, so that $K = u + v$. Both u and v are independent and normally distributed. Knowing u reduces but does not eliminate the risk associated with the asset. Some investors choose to become informed about u, therefore their per capita demand, D_i, will depend on both the price (P) of the asset and u,

$$D_i=D_i(P,u).$$

Demand is assumed to be increasing in u and decreasing in P. The per capita demand of the uninformed, D_j, depends only on P,

$$D_j = D_j(P).$$

Equilibrium in each period requires that supply, S, equal demand

$$S = f[D_i(P,u)] + (1 - f)[D_j(P)],$$

where f is the fraction of the individuals who are informed.

Given these basic conditions, it follows immediately that the uninformed can infer u if there are no other sources of uncertainty in the model (e.g. fixed supply and deterministic demand). That is, since the informed will exhibit higher demand associated with higher values of u, there will be precisely one u corresponding to any price. This price system is fully revealing, conveying all information from the informed to the uninformed, since the conditional distribution of K given P is the same as the conditional distribution of K given u.

However, if additional sources of uncertainty are admitted (e.g. stochastic demand and uncertain supply), prices will convey some but not all information. That is, when P is high it may be because u is high, but it may also be due to a low supply of the risky asset, or a shift in the demand function of the informed investors. Thus, corresponding to any P, there will be a distribution

of possible values of u. The price system conveys some information, because on average, when P is high, the return K is high (P and u are correlated), but the price signal is noisy in that P and u do not convey the same information about K.

This outcome leads to a demand for information production about u. Note that when no one is informed, the price system does not convey any information, and the value of incremental information about u is high. On the other hand, when almost everyone is informed, the price system is very informative, so the value of knowing u with precision is small. The result is an equilibrium in which the price conveys some information but does not fully reveal all information. The fraction of the investors who opt to become informed (as contrasted with those who infer something about the information from prices) determines how fully the information is revealed. Further, at equilibrium it would be predicted that the marginal investor finds the expected utility of being informed is equal to the expected utility of remaining uninformed.

These results provide a form of market efficiency that is weaker than pure strong-form efficiency, where expectations are determined completely endogenously. Strong-form efficiency is not appealing on empirical grounds simply from the observation that individuals do place value on the production of private

information. On the other hand, these results also provide an escape from a complete exogeneously formation of expectations, which would not be rational if prices do reveal some useful information. In other words, in a market characterized by prices that are only partially revealing, an individual will utilize endogenous variables such as prices in forming expectations, because he benefits from the bits of impounded information that have been collected by others. At the same time, because prices are not totally revealing there remains an incentive to collect private information.

This argument creates a theoretical role for the function of private information production in the formation of investor expectations in a market that is otherwise efficient. It then becomes an empirical question as to whether security analysts' outputs or the information outputs of other agents or methods better explain the actual structure of prices.

2.3 The Role of Consensus Expectations

Although a theoretical justification for the role for security analysts (as producers of private information) in the formation of investor beliefs and expectations has been established, it is still necessary to show that security prices might actually imbed a consensus measure of those beliefs. At an intuitive level Brigham, Vinson, and Shome (1983) have argued,

> Although individual investors act independently in arriving at their individual buy, sell, or hold decisions, the observed market price of a stock reflects the consensus view of all investors regarding its future growth. Therefore, the consensus of analysts' forecasts is embodied in market prices. Of course, this argument depends on the assumption that investors do actually use analysts forecasts and that market prices are based on these forecasts. However, it is not required that all or even the majority of investors utilize analysts' forecast information: If there are sufficient numbers of large institutional investors, with adequate financial backing, who do use analysts' forecasts, then they will trade in a security until its market price reflects their intrinsic valuation and, hence, the forecasts of analysts. (Page 23)

The purpose of this section is to develop a theoretical underpinning for this seemingly plausible argument. To begin this analysis, assume, in addition to the conditions of the Grossman-Stiglitz model of the prior section, that there is only one source of information about u. In this case, it would be highly redundant and inefficient for any investor, other that the first, to become informed because they would all receive the same piece of information. With only one source of information, the Grossman-Stiglitz model reduces to a polar example of asymmetric information, investors are either informed or uninformed, but there are no degrees of informational accuracy or diversity of beliefs. In the Grossman-Stiglitz model prices can not aggregate diversity of beliefs or expectations, simply because there is no diversity of opinion.

In order to obtain a role for consensus beliefs, it is first necessary to construct a richer model of prices and the formation of expectations that incorporates both asymmetric information and diversity of opinion, and yet, still retains the notion of market efficiency.

By imposing a structure of preference functions over the marketplace and by allowing investors to engage in a process of acquiring private information beyond that contained in stock prices, it is possible to derive an analytic expression for the consensus expectation and to determine the necessary conditions that would embed that consensus into the market clearing price.[1]

Before beginning the development of such a model, a simple example will be used to establish where the analysis should lead. First, assume that a market is composed of two investors who are identical in all respects except the following. One investor has formed his expectation of say, growth in dividends, over a highly optimistic information set, O. The other investor has formed her expectations over a highly pessimistic

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[1]This analysis is similar to that of Verrecchia (1980). The analysis is cast in terms of the expected rate of return on a risky security and the variance of that expectation. If it is assumed that the primary source of uncertainty in those expectations is the anticipated growth rate, then it would be appropriate to replace the expected rate of return with an expression for expected growth and to replace the variance of the expected return with a measure of the variance of expected growth. The analysis would proceed as before, except that the resulting expression for the consensus expectation would be for the growth term.

information set, P. Assume further, that trading between the two investors results in a price that reflects the "average" expectation. The average information set, A, is the union of O and P.

Next, allow entry of a third investor who knows information set A. The third investor is clearly better informed than the other two since his information set the contains the relevant bits of information of each of the others. At the same time, there is no way he can earn an excess return from this informational advantage because the equilibrium price has been determined on the basis of the consensus belief.

It is this notion of informational efficiency that is to be pursued. As Rubenstein (1975) has suggested, a necessary and sufficient condition for informational efficiency is that an individual perceive that all of his information is fully reflected in prices. In other words, even if an investor possesses additional information as compared to the information possessed by other individual market participants there will not be possibilities of gains to his informational advantage, if his additional information is reflective of the consensus expectation.

However, it is also possible that the optimistic investor held a vastly superior expectation, in the sense that he had devoted significant time and expense in formulating a more accurate expectation than the pessimist. Then it is not clear that the averaging

process between those two investors would take place. Instead, driven by his superior knowledge, the optimistic investor could buy the security from the pessimist at a bargain price and earn excess returns. Therefore, the critical condition for the market clearing price to reflect a consensus expectation is that no investor have "better" information than that contained in the consensus. That is, ex ante, for informational efficiency to obtain, the consensus expectation must be at least as accurate as any individual's personal expectation, or it will be possible for that investor to capture excess returns from his private information.

2.4 A Model of Information Acquisition, Diverse Opinion and Consensus Expectations

The following notation is used to develop the analytic framework for examining the role of consensus expectations in determining equilibrium prices:

R_f is the periodic rate of return on a risk free security.

k'_i is the expected periodic rate of return on the risky security before private information is obtained. It is the prior expected value held by investor i.

$s^{2\prime}_i$ is the variance of the expected rate of return on the risky security before private information is obtained.

k''_i is the expected periodic rate of return on the risky security indicated by the private information obtained by investor i. It is the mean of her sample of information.

$s^{2\prime\prime}_i$ is the variance of the expected rate of return on the risky security indicated by the private information

obtained by investor i. It is the variance of the sample of information.

k_i is investor i's posterior belief about expected rate of return on the risky security after obtaining private information. It is formed by combining the prior expectation with the private information.

$s^2{}_i$ is investor i's posterior belief about the variance of the expected rate of return on the risky security. It is formed by combining the prior belief with the private information.

$U_i(W)$ is investor i's utility function of wealth, W.

a_i is investor i's Pratt-Arrow coefficient of absolute risk aversion. It is defined as

$$a_i = \frac{-U''(W_i)}{U'(W_i)},$$

where ' and " denote first and second derivatives of the utility function with respect to wealth, respectively.[2]

n_i is the number of sample observations taken by investor i in acquiring private information.

P is the equilibrium price of the risky security.

C(n) is the cost of obtaining private information as a function of the number of observations taken. The cost function is assumed to be common to all investors.

S^R is the (unlimited) supply of the risk free security.

S^K is the fixed supply of the risky security.

$D_i{}^R$ is investor's demand for the risk free security.

$D_i{}^K$ is investor i's demand for the risky security.

m is the true but unknown mean of the distribution of the random rate of return on the risky security.

v^2 is the true and unknown variance of the distribution of the random rate of return on the risky security.

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[2]See, for example, Alexander and Francis (1986).

Investors enter the market with unequal endowments of wealth, W. They are offered the opportunity to purchase either the risk free security, R, or a risky security, K. The risk free security offers a certain return of R_f at the end of some future period. Before trading and information acquisition activities begin, the random return on the risky security is believed by investor i to be normally distributed with mean return, k'_i, and with variance, $s^{2\prime}_i$.

Before engaging in trading, investors have the opportunity to acquire additional, private information about the risky security. The information acquisition process will be described as a sampling process, with samples drawn from a normal probability distribution.[3] This additional information is characterized as a sample of predetermined size n observations, $x_{i1}, \ldots, x_{in}$, which are known to be independently and identically normally distributed with mean, m, and variance, v^2.

Under the conditions described above Raiffa and Schlaifer (1961) have shown that investor i will have a posterior (after obtaining private information) belief that the rate of return on K is distributed normally with

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[3]In more descriptive terms, the investor might first acquire information from security analyst A at some dollar cost. Then she might seek additional information from security analyst B at an additional dollar cost and so forth. Or, in a different context, the quality and accessibility of information may vary with cost.

a mean of k_i, and variance, $s^2{}_i$, where the following definitions apply:

$$k_i = \left(\frac{k'_i}{s^{2\prime}{}_i} + \frac{n_i k''_i}{s^{2\prime\prime}{}_i} \right) s^2{}_i \qquad \text{(i.)}$$

where

$$k''_i = \sum_t \frac{x_{ti}}{n_i}, \quad t = 1 \text{ to } n_i, \qquad \text{(ii.)}$$

and

$$\frac{1}{s^2{}_i} = \frac{1}{s^{2\prime}{}_i} + \frac{n_i}{s^{2\prime\prime}{}_i} \quad . \qquad \text{(iii.)}$$

The posterior expectation is a weighted average of the prior mean and the sample mean, with the weights being the reciprocals of the variances of the the two distributions. The weight received by the sample mean also depends on n_i, the size of the sample. Thus, as the amount of sample information increases, the posterior mean is more influenced by the sample results. The reciprocal of the posterior variance is the sum of the reciprocals of the variance of the prior and the sampling distributions. This implies that the posterior variance is smaller than either the prior or sample variance. In other words, there is less uncertainty in the posterior distribution than in either of the other two.

Investor i wishes to maximize her expected utility of future wealth by choosing holdings of R and K based upon the posterior expectations formed over her private information. The more information, that is, the more

sample observations she takes, the more strongly held will be her beliefs about the expected rate of return. Or, in a statistical sense, the smaller will be her posterior expectation of the return variance. However, that information is costly to obtain. It is assumed that the cost of acquiring information can be described by the the function, $C(n)$, where C is increasing and twice differentiable in n. Thus, the formal problem facing investor i is to

$$\underset{(n_i, D_i^R, D_i^K)}{\text{Maximize}} \int_m \int_K U(W_i)\, dF(k_i, s^2{}_i) dF(k, s^2) \quad , \qquad (1)$$

subject to $W_i = D_i^R + PD_i^K + C(n_i)$.

If it is assumed that all investors have exponential utility functions of the form

$$U(W_i) = -a_i(W) e^{-a_i(W) W_i} \quad , \qquad (2)$$

a tractable closed form solution to the maximization problem can be determined which in turn results in an explicit formulation of the consensus belief.[4] This is so because a well known economic property of the

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[4]The assumption of an exponential utility function is primarily due to the ease of algebraic manipulation it permits. When investors have heterogeneous expectations, the existence of consensus beliefs as determinants of equilibrium security prices is well accepted in the finance literature even in the absence of a explicit derivation. See, for example, Lintner (1965) or Verrecchia (1979).

exponential utility function is constant absolute risk aversion,

$$a_i(W) = \frac{a^3{}_i e^{-a_i(W)W_i}}{a^2{}_i e^{-a_i(W)W_i}} = a_i \quad ,$$

or that the coefficient of risk aversion is independent of wealth.

Substitution of (2) into (1) allows an explicit formulation of the maximization problem as

$$\underset{(n_i, D_i{}^R, D_i{}^K)}{\text{Maximize}} \int_m \int_K -a_i e^{-a_i(R_f D_i{}^R + m D_i{}^K)} dF(k_i, s^2{}_i) dF(k, s^2), \qquad (3)$$

subject to $W_i = D_i{}^R + D_i{}^K P + C(n_i)$.

The price of the risk free security is taken to be the numeraire. That is, its price is normalized to one.

Conditional upon a value for n, say $n^*{}_i$, optimal holdings of the risk free and the risky security can be determined from the solution to the following LaGrangian equation:

$$L(D_i{}^R, D_i{}^K, l_i) = - \int_m a_i e^{-a_i(R_f D_i{}^R + m D_i{}^K)} dF(k_i, s^2{}_i)$$

$$+ l_i \{W_i - [D_i{}^R + D_i{}^K P + C(n^*{}_i)]\}. \qquad (4)$$

Taking derivatives of (4) with respect to $D_i{}^R$ and $D_i{}^K$, and recognizing that necessary first order conditions implies that

$$\frac{dL_i}{dD_i{}^R} = \frac{dL_i}{dD_i{}^K} = 0 \quad .$$

An expression for the price of the risky security determined by investor i's optimal demands is then given by

$$P = \frac{\int_{me} -a_i(R_f D_i^R + mD_i^K) \, dF(k_i, s^2{}_i)}{\int_{Re} -a_i(R_f D_i^R + mD_i^K) \, dF(k_i, s^2{}_i)} \quad . \tag{5}$$

Integrating and simplifying (5) results in

$$P = \frac{k_i \; -(s^2{}_i a_i D_i^K)}{R_f} \quad . \tag{6}$$

And rearranging terms results in a determination of the individual investor's demand for for the risky security as

$$D_i^K = \frac{(k_i \; - \; R_f P)}{a_i s^2{}_i} \quad . \tag{7}$$

Summing over all I investors yields the total demand for the risky security as

$$D^K{}_{TOTAL} = \sum_I \frac{(k_i \; - \; R_f P)}{a_i s^2{}_i} \quad . \tag{8}$$

Then equating total demand with supply, $D^K{}_{TOTAL} = S^K$, allows a specification of the equilibrium price as a function of the aggregate expectations of all investors in the form of

$$P = \frac{\left(\sum \frac{V_0 k_i}{a_i s^2{}_i}\right) \; - \; S^K V_0}{R_f} \quad , \tag{9}$$

where the term V_0 is a constant across all investors, that is, $V_0 = \sum a_i s^2{}_i$.

The term, $\sum(V_0k_i / a_is^2{}_i)$, can be thought of as a type of geometric weighted average of individual investor expectations of the risky security's rate of return, where the weights are the product of the individual preferences for risk and the posterior variance estimate each investor brings to the marketplace. Note that V_0 is a constant, and that $\sum(V_0 / a_is^2{}_i) = 1$, thus confirming that those terms are weights and their sum can can be normalized to unity.

Next, multiply both numerator and denominator by $1/V_0$, and define

$$q_i = \frac{a_is^2{}_i}{V_0} \quad . \tag{10}$$

Then the consensus expectation can be written as

$$\sum \frac{V_0k_i}{a_is^2{}_i} = \sum \frac{1}{q_i} k_i \quad . \tag{11}$$

Inspection of (11) indicates that the expectations of investors with smaller coefficients of risk aversion (more risk tolerant) will have greater impact on the consensus expectation. Similarly the expectations of investors with beliefs of a smaller variance of returns will also receive greater weight in the consensus.[5]

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[5]Note that $a_is^2{}_i$ is equivalent functionally to the Pratt-Arrow risk premium $[v^2/2][-U''/U']$ and q_i represents investor i's proportionate contribution to the market price of risk. In effect, q_i "shrinks" the mean expectation, k_i, by an amount necessary to offset the individual's perception of the investment's riskiness.

In the same sense that the union of the information sets of the optimistic and pessimistic investors represented the consensus expectation in the simple example presented above, the term

$$\sum \frac{v_0 k_i}{a_i s^2_i}$$

is also a consensus expectation.

To demonstrate that this is also the consensus expectation that is contained in a price determined in an informationally efficient market, it is sufficient to show that that no individual investor has expectations that are more accurate than the consensus. Under Rubenstein's definition of market efficiency, it is sufficient to to demonstrate that, <u>ex ante</u>, the consensus expectation is at least as accurate as any individual expectation. This is equivalent to showing that no one can earn excess returns from their private information. In the statistical framework of this model, a determination of the relative accuracy of information is equivalent to comparing the respective variances of an individual's posterior distribution to the variance of the distribution of the consensus expectation.[6] The formal condition is stated

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[6]A more formal justification of using the variance as a measure of informational accuracy can be found in Shannon (1948) or Thiel (1971). For non-symmetric distributions, the notion of informational entropy is more general. However, the entropic measure provides the same relative assessment of accuracy as the variance measure when distributions are normal.

as follows:

$$\mathrm{Var}\ \left(\sum \frac{1}{q_i} k_i\right) \leq s^2{}_i, \quad \text{for all } i,\ i=1 \text{ to } I. \qquad (12)$$

Noting that the variance of k_i is simply $s^2{}_i$, and assuming that each investor's expectation is independent of other investors' expectations, the variance of the consensus expectation is given by

$$\mathrm{Var}\ \left(\sum \frac{1}{q_i} k_i\right) = \sum \left(\frac{1}{q_i}\right)^2 s^2{}_i. \qquad (13)$$

Which must be less than or equal to the variance of any individual investor's posterior distribution of expected returns for market efficiency to obtain. Inspection of (13) indicates that the variance of the consensus expectation will be tilted in favor of the variances of investors with small coefficients of risk aversion. This is so, because the weight given their posterior estimate of the variance in the summation will be greater than investors with large coefficients of risk aversion. And in general, for the condition stated in (12) to hold, investors with less aversion to risk must contribute better (more precise, lower variance) assessments toward determining the market clearing price than those investors with greater risk aversion.

A basic assumption of the analysis is that any individual investor exhibit constant absolute risk aversion. However, it seems reasonable to believe that

among investors, those with more wealth will be less risk averse than those with lower wealth. Thus, smaller coefficients of risk aversion should, in general, be associated with investors with greater wealth. These less risk averse investors will, most likely, allocate proportionately more of their wealth to investments in the risky security, K, which in turn implies they will hold larger absolute amounts of the risky security. If this is indeed a reasonable depiction of the characteristics of market participants, investors with greater risk tolerance (lower risk aversion) may be expected to safeguard their greater investments in risky assets by demanding more information about those assets.[7]

The implications of this analysis are clear, if there is an increasing cost to obtaining information, then the degree of risk aversion will determine how much additional information an investor acquires. In this situation, the most risk tolerant investor will acquire the most

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[7]Following this economic logic, Verrecchia (1980) has shown that under assumptions equivalent to those made in the development of this model, the formal sufficient condition for the weak inequality in (12) to hold is that the demand for information (the size, n_i, of sample information) be an decreasing function of the coefficient of risk aversion. But this condition is simply the same as saying that investors act in their own best interests by protecting their investments in the risky security by seeking to acquire private information beyond that contained in prices. Since acting in one's self interest is fundamental to the operation of a competitive marketplace, this requirement does not seem to be very demanding.

additional information. This further implies that the most risk tolerant investor will, in general, be the best informed in the sense that he or she holds the smallest expectation of the variance of expected returns on the risky security. Finally, this implies that the market clearing price and the consensus expectation that is impounded in it, will be weighted in favor of the individual expectations of the more informed investors with greater risk tolerance, presumably the large institutional investors with large wealth endowments. And from this theoretical perspective, the bases for the intuitive arguments of Brigham, Vinson, and Shome (1983) appear to be justified.

2.5 Divergence of Opinion as a Risk Factor

Several authors, including Miller (1977), Cragg and Malkiel (1982), Peterson and Peterson (1982), and Varian (1985) have noted that in a market where diverse and heterogeneous opinions aggregate to determine prices, a measure of the amount of diversity may be an important determinant of a security's riskiness. If this observation is correct, and accepting the theme of this thesis that security analysts' forecasts are important determinants of investor expectations, then it follows that a measure that might be highly correlated with the diversity of investor expectations is a measure of the diverse nature of analysts' forecasts.

In the review of the empirical literature that follows in Chapter Three, this topic is examined. At this point, however, the goal is somewhat more abstract. In Section 2.4, a model was developed that demonstrates, under plausible conditions, an equilibrium determination of stock prices that is reflective of a consensus of individual expectations. That model is now to be extended in a way that permits a prediction of how stock prices will respond if the diversity of the consensus expectation increases. More specifically, if it can be shown in a comparative static analysis that the equilibrium stock price declines when the diversity of the consensus increases, then increasing diversity can be theoretically associated with increasing risk.

The first consideration of this analysis is to determine how a change in the individual posterior variance estimates impacts the diversity of the consensus expectation and ultimately the equilibrium stock price. Note that in equilibrium, the price at a given supply of the risky asset and a known value for the risk free rate of interest, is largely a function of variables, k_i and q_i, where q_i is a function of a_i and $s^2{}_i$,

$$P = \frac{\sum \frac{1}{q_i} k_i \quad - \quad V_0 s^K}{R_f} \quad , \qquad (14)$$

and where $q_i = a_i s^2{}_i \,/\, V_0$, and $V_0 = \sum a_i s^2{}_i$.

Recalling that k_i and s^2_i are the parameters of the posterior distributions of expectations and are determined under the definitions given in [iii.] allows a writing of s^2_i as follows:

$$s^2_i = \frac{s^{2''}_i(s^{2'}_i)}{s^{2''}_i + n_i(s^{2'}_i)} .$$

Clearly an increase in the variance of the sample information $s^{2''}_i$, leads to an increase in the posterior variance as shown by

$$\frac{ds^2_i}{ds^{2''}_i} = \frac{s^{2'}_i(n_i)}{(s^{2''}_i + s^{2'}_i(n_i))} > 0 \quad .$$

In a similar fashion, an increase in the prior variance for a given sample variance and sample size would lead to an increase in the posterior variance. Thus, in general, any increase in the uncertainty of the prior beliefs or a diminution of the quality of private information will lead to increased uncertainty about the posterior expectation. This would in turn lead to an increase in q_i given by

$$\frac{dq_i}{ds^2_i} = \frac{a_iV_0 - a_i{}^2s^2_i}{(V_0)^2} > 0,$$

because all terms in V_0 are positive and $a_iV_0 > a_i{}^2s^2_i$.

Because the weights applied to the individual return expectations are the reciprocals of the q_i, an increase in q_i leads to a decrease in the weighting. For fixed k_i, this leads to a reduction in the consensus expectation. Inspection of (14) indicates a reduction in the consensus

expectation will lead to a reduced equilibrium price. Thus, in an almost trivial sense, for constant risk aversion and an increase in the individual posterior variances that does not alter the individual beliefs about the posterior mean, the stock price will unambiguously decline.

An examination of (13) indicates that an increase in $s^2{}_i$ will also lead to an increase in the variance of the consensus distribution. This is so because the consensus variance will directly increase with increases in $s^2{}_i$ but will only indirectly decrease through proportionately smaller decreases in the weights. Under the assumed structure of preferences and distributions of expectations, an increase in the dispersion of individual beliefs leads to an increase in the dispersion of the consensus. Therefore, either event, increased individual uncertainty or increased consensus uncertainty leads to a lower equilibrium stock price.

The analysis becomes less clear when the assumption of constant absolute risk aversion is dropped. In that case it is no longer possible to evaluate the integral in (1) explicitly and therefore a closed form expression for the consensus expectation and the variance of the consensus can not be derived. Heuristically, the coefficient a_i becomes a function of expected terminal wealth which is in turn influenced by the cost of sample information and changes in the posterior return

distribution. Thus, if the assumption of constant absolute risk aversion is dropped and no restrictions are placed on the manner in which the posterior distributions can change, no analytical prediction of the risk effects of increasing diversity of opinion can be made.

If changes in the posterior distributions of returns are restricted to changes that alter the posterior variance but leave the posterior mean unchanged, some additional implications can be obtained by relaxing the assumption of constant absolute risk aversion.

To begin, redefine $q_i = (a_i(w_i)s^2{}_i)/V_0$, where V_0 is now $\Sigma a_i(w_i)s^2{}_i$.[8] Note that a_i is now assumed to be a function of terminal wealth and will more generally, not be a constant value as assumed previously. To obtain a decrease in his posterior variance, $s^2{}_i$, an investor will find it necessary to acquire more sample observations. However, with increasing marginal cost of obtaining that information, expected terminal wealth will decrease with each additional unit of information obtained. If the coefficient of risk aversion increases "too fast" with

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[8]At this point it is assumed that the basic form of the consensus expectation is equivalent to the form derived under conditions of constant risk aversion. That is, the consensus is at least a positive function of the geometric weighted average of individual expectations. That this is generally true can be derived from Litner's (1967) determination of the consensus expectation. This part of the analysis can also begin from the Pratt (1964) or Arrow (1971) determination of the individual's required risk premium as $(s^2{}_i/2)(-U''{}_i/U'{}_i)$ which is functionally equivalent to $q_i = a_i(w_i)s^2{}_i$.

decreases in terminal wealth, it is possible that reductions in the variance will not offset increased risk aversion. In other words even though the returns on the security become more certain, the investor becomes proportionately risk averse. If this is the case, stock prices will decline with reductions in the consensus variance instead of rising. In that event, a change in the the diversity of the consensus expectation cannot be directly associated with risk.

Algebraically, if

$$q_i = \frac{a_i(w_i)s^2{}_i}{V_0}$$

and letting $V_0 = a_i(w_i)s^2{}_i + Y_0$, where $Y_0 = \sum a_j(w_j)s^2{}_j$, then

$$q_i = \frac{a_i(w_i)s^2{}_i}{a_i(w_i)s^2{}_i + Y_0} \quad .$$

And letting $r_i = 1/q_i$ indicates

$$r_i = \frac{a_i(w_i)s^2{}_i + Y_0}{a_i(w_i)s^2{}_i} \quad . \tag{15}$$

Defining r_i in this way allows a more direct inspection of the of the changes that occur when a variable takes a new value. In effect, r_i is the weight each investor brings to the consensus expectation.

The goal is to determine how changes in $s^2{}_i$ that are brought about by an increased acquisition of information ($dn_i > 0$) change the variance of the consensus expectation. In addition to the assumptions of the

previous analysis, $a_i(w_i)$ will also change with $dn_i > 0$, but generally in an opposite direction from $s^2{}_i$.

Utilizing (15), re-write the consensus expectation as, $(r_i)k_i$. The total differential of the expectation for a given change in the number of sample observations acquired is

$$\left(\frac{d(r_i)}{ds2_i}\,\frac{ds^2{}_i}{dn_i}\right) + \left(\frac{d(r_i)}{da_i(w_i)}\,\frac{da_i(w_i)}{dw_i}\,\frac{dw_i}{dC(n)}\,\frac{dC(n)}{dn_i}\right)dn_i$$

$$x\left(\frac{dki}{dn_i}\right)dn_i\ . \qquad (16)$$

Manipulation of (16) indicates that in order for a change in $s^2{}_i$ brought about by a change in n_i to offset the countervailing effect of a change in $a_i(w_i)$, so that the consensus expectation increases, the following must hold as a necessary condition,

$$\frac{ds^2{}_i}{s^2{}_iC'} \leq \frac{a'{}_i}{a_i(w_i)}\ , \qquad (17)$$

where $a'{}_i$ is the first derivative of the coefficient of risk aversion with respect to wealth, C' is the first derivative of the information cost function with respect to n, and dn_i has been normalized to unity. From Pratt (1964) or Arrow (1971) it is well known that $a_i(w_i)$ is positive. Further, a positive C' is economically acceptable, and the left hand side of (17) is negative. Therefore, (17) will always hold if $a'{}_i$ is positive. The

quadratic utility function exhibits this property.[9] The negative exponential utility function has $a'_i = 0$, so it will also fulfill the requirement. For functions with $a'_i < 0$, such as the logarithmic and power functions, certain additional restrictions must be imposed to ensure that the consensus expectation will increase with increased sampling that brings about decreased variance at the expense of decreasing wealth. These restrictions are relative and somewhat interdependent, and may, therefore, hold either singularly or in some combination: (1) if the incremental cost of additional information is small or (2) if the sample data is informative so that ds^2_i is large. Note also that $a'_i/a_i(w_i)$ reduces to $-1/w_i$ for logarithmic and power functions, which in turn will be very close to zero for most investors with these types of utility functions.[10]

In general, most utility functions assumed in the finance literature or supported by empirical studies will

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[9]See, for example, Alexander and Francis (1986), page 26, for a discussion of the properties of various functional forms assumed for utility functions.

[10]The generic log function, $U=\ln(w_i)$, indicates $a_i(w_i)=1/w_i$, and $a'_i=-1/w_i^2$, therefore $a'_i/a_i(w_i)=-1/w_i$. The generic positive power function, $U=w_i^c$, indicates $a_i(w_i)=(1-c)/w_i$, and $a'_i=-(1-c)/w_i^2$, therefore $a'_i/a_i(w_i) = -1/w_i$. The generic negative power function, $U=-w_i^{-c}$, indicates $a_i(w_i)=(1+c)/w_i$, and $a'_i=-(1+c)/w_i^2$, therefore $a'_i/a_i(w_i)=-1/w_i$. Certain restrictions must be placed on parameter c, see, for example, Alexander and Francis (1986).

exhibit the properties of risk aversion in a manner which will cause (17) to hold.[11] In summary, from a theoretical perspective, an increase in the diversity of the expectations of individual investors may increase or decrease equilibrium security prices depending upon the value of a'_i of the utility function. However, the most likely effect is to decrease security prices.

2.5 A Simulation Analysis of the Weighting in the Consensus Expectation

Utilizing equation (11), the algebraic expression for the consensus expectation that was developed in Section 2.3, and taking point estimates of the relevant values of risk aversion from the studies of Blume and Friend (1975), Grossman and Schiller (1971), and Litzenberger and Ronn (1986), and point estimates of security returns and associated variances from the Ibbotson and Sinquefield (1982) studies, simulation analyses of the individual investor's contribution toward the market clearing consensus expectation were performed. Investor i's expectation of the return on a hypothetical risky security was generated by taking the simple mean of twenty random observations drawn with replacement from a

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[11]The empirical research of Blume and Friend (1975), Grossman and Schiller (1971) and Litzenberger and Ronn (1986) generally support coefficients of <u>relative</u> risk aversion above one. This would be consistent with the types of utility functions which would exhibit the necessary properties required to support diversity of opinion as a risk measure.

normal distribution with parameters established by reference to Ibbotson and Sinquefield,

$$k_i = \sum x_{in}/20 \ .$$

Investor i's coefficient of risk aversion was obtained by a random draw from a distribution of such coefficients based on references to the empirical results of the above studies. Several different types of distributions of risk aversion coefficients were utilized in the simulations, including distributions that were symmetric about a mean coefficient and those that were skewed toward lower and higher values.

Next, an estimated posterior variance was calculated for each expectation. At this point, however, variances were ranked from smallest to largest and disassociated from any particular expectation. The smallest variance was assigned to the investor with the greatest risk tolerance coefficient, and so on, until the investor with the lowest risk tolerance coefficient was assigned the greatest measure of variance. This is in keeping with the inference of the self interest nature of the model.

Using different types of distributions of risk aversion coefficients with hypothetical markets consisting of 100 to 10,000 investors, numerous simulations were performed. The consensus expectation of the risky security's mean return was calculated as the weighted sum of individual expectations. Where the

weights, as shown in (11) are the product of individual variance estimates multiplied by the individual risk aversion coefficients normalized to their total weighted sum.

The results of all of the simulations were remarkably stable, indicating little differential impact due to the choice of distributions or number of market participants. For example, a representative simulation indicated that the individual expectations of the 40 percent of investors with the highest risk aversion contribute slightly less than 15 percent of the weight towards the consensus expectation. Whereas, the individual expectations of the 20 percent of investors with the least risk aversion contribute almost 50 percent of the weight of the consensus expectation. Noting that the simulation results do not account for possible differences in wealth and the size of trades of the market participants, the results are most likely conservative in terms of the true impact large, risk tolerant investors actually have on consensus expectations. As a crude rule of thumb, it is generally stated that 70 percent of all stock market activity is attributable to institutional investors. If that ratio mapped into the simulation results, it would indicate that more than 90 percent of the weight in the consensus expectation is attributable to the individual expectations of institutional investors.

CHAPTER THREE

A REVIEW OF THE EMPIRICAL LITERATURE

3.1 Introduction

The existing empirical literature and research that is important to this study of security analysts' forecasts generally falls into two categories. The first topic, which is covered in Section 3.2 is the empirical literature that examines the security analysts' forecast of short-term values. This research can be decomposed into three distinct types of comparative studies, (1) evaluations of short-term forecasts against naive extrapolations of historical time series, (2) evaluations of security analysts' forecasts against forecasts made by management, and (3) evaluations of short-term forecasts among security analysts. Often, this research is characterized by tests of the forecast accuracy of security analysts vis-à-vis other forecast agents or methods, the diagnosis of forecast error or the influence of unexpected changes in short-term forecasts on share prices. There is an extremely large body of literature in this area; therefore, this review concentrates on the more recent, representative articles.

The second topical area, reviewed in Section 3.2, and the one that is of primary importance to this

study, includes the examinations of security analysts' forecasts of long-term growth. In contrast to studies about short-term forecasts, this area has received little research attention, a fact most likely due to the limited types and small amount of data that have been available for analysis. The focus of this section of the literature review will be the work of Cragg and Malkiel who have provided the seminal (1968) and the most comprehensive (1982) examinations of long-term forecasts and the recent extensions to Cragg and Malkiel.

In Chapter Two, a theory was developed of how security analysts' forecasts might be incorporated into individual investor expectations and ultimately into a consensus expectation embedded in the market clearing price. This chapter explores the question of why security analysts' forecasts might be important in the formation of investor expectations. A general point to keep in mind in reviewing this literature on security analysts' forecasts, is that either one of two distinct theories can be invoked as a basis for their importance in the actual formation of expectations. The older of the theoretical views can be traced to the celebrated beauty contest of John Maynard Keynes (1935/1964), where

> professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preferences of the competitors as a whole; so that each competitor has to pick, not those faces which he himself

> finds prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at problem from the same point of view. (Page 132)

The theory emanating from this view indicates that it is more important to know what the market thinks or expects, say, earnings per share or earnings growth will be than to know precisely what actual earnings or growth are realized. Under this theoretical specification, security analysts' forecasts are tested against forecasts from other sources to determine which type of forecast methodology best explains the cross-sectional structure of share prices or the cross-sectional structure of price/earnings ratios. The forecast that provides the best explanation of the structure is then inferred to be representative of the market expectation. This view holds that it is not the ultimate accuracy of forecast methods that is important but rather how strongly a particular type of forecast influences the formation of investor expectations.

The more recent theoretical view is a product of the rational expectations literature. Brown and Rozeff (1978) claim that rational investors incorporate into their expectations only the most most useful information which, by extension from the definition of rationality, is the most accurate information. This theoretical perspective motivates the measurement and comparison of forecast

errors produced by security analysts' forecasts with errors produced by alternative forecast methods.

To date, the empirical results from the tests of security analysts' forecasts cannot be used to distinguish between the existence of a marketplace dominated by investors forming expectations about what they believe to be the best forecasts of future values (rational expectations) or by investors forming expectations over what they believe other market participants to be forecasting (Keynesian beauty contest). Empirical results tend to indicate that the structure of security prices is best explained by security analysts' forecasts and that security analysts' forecasts tend to have the smallest forecast error. Note, however, that under a theory of rational expectations, forecasted values that are derived from the best forecasting method should also be expected to offer the best explanation of cross-sectional variation in price structure, as that method is used in the formation of expectations. On the other hand, a theory of the formation of investor expectations in keeping with the Keynesian beauty contest does not rule out security analysts' forecasts as being the best predictors of future values. That is, forecast accuracy is neither a necessary nor a sufficient support for that theory. Thus, hypotheses formulated under one theory do not, in general, have testable implications that are distinct

from implications of hypotheses formed under the other theory.[1]

A knowledge of the correct model of the formation of investor expectations would be a valuable asset in determining the usefulness of security analysts' long-term forecasts in the discounted cash flow model of estimating the cost of capital. That is, a knowledge of that model would allow prediction of a benchmark measure of long-term growth expectations against which security analysts' forecasts could be measured. However, neither observations of actual expectations nor sound theoretical predictions are possible, thus this study will of necessity rely on statistical inference coupled with reasoned economic logic.

As such, the literature review focuses equally on logical assumptions, data sources, application of statistical methods, and resulting conclusions of existing empirical studies. For it is the dual purposes of this study to identify and offer correction of methodological infirmities of existing studies as well as to extend the

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[1]One discriminating test has been suggested by Cragg and Malkiel (1982). They claim that the showing that a forecast methodology both produces superior forecast accuracy and explains cross-sectional price structures consistently over an extended period of time would be necessary although not sufficient for the existence of rational expectations and, therefore, a positive result from these joint tests would provide weak support of that hypothesis. However, the lengthy time series of the types of data that are required for this examination simply do not exist.

body of knowledge regarding security analysts' forecasts of long-term growth.

3.2 The Empirical Literature on Security Analysts' Short-term Forecasts

3.2.1 Barefield and Comiskey (1975)

This article reports on a study of analyst forecasts of one-year-ahead earnings per share (EPS) for a 100 company sample of New York Stock Exchange firms. Barefield and Comiskey (BC) analyze forecasting performance by year and by industry classification in relation to a naive mechanical forecasting rule. In addition to the examination of forecast error, BC investigate analysts' abilities to predict "turning points" in a company's earning series.

As a source of analyst forecasts, BC used the Standard and Poor's Earnings Forecaster. The forecasts are provided to Standard and Poor's by brokerage houses, and other Wall Street researchers and analysts. As reported by BC, two to three forecasts per company was the norm, although the number of forecasts varied positively with the size of the firm and the volume of trading activity. Barefield and Comisky drew a 100 company sample that satisfied three constraints: (1) the company had a December 31 fiscal year-end; (2) the company was listed on the New York Stock Exchange; and (3) the company was included in the Earnings Forecaster at each observation point over the period 1967 to 1972. The basic sample

consisted of 600 observations, forecasts of the next year's EPS for 100 companies for each of 6 years.

Each year's forecast was defined as the simple average of the individual analyst forecasts provided. The forecasts were measured approximately ten months prior to the end of the respective fiscal year. Barefield and Comiskey defined annual forecast error (FE) as the absolute value of the percentage difference between actual and forecasted EPS,

$$FE_t = |F_t - A_t| / F_t,$$

where F_t = forecast of EPS_t for year t, and A_t = actual EPS_t for year t.[2] They also defined an average forecast error (AFE) over the six year period as

$$AFE = (1/6) \sum FE_t.$$

In addition to computation of forecast error, BC also investigated analysts' abilities to predict turning points in a company's earnings stream over the six year period. For example, suppose that analysts are predicting year-over-year positive changes in EPS for three years, symbolically the predicted series would be +++. If the actual earnings changes turn out to be two years of positive changes follow by a decrease in EPS, which is the

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[2]As defined, FE_t is the mean absolute error which implicitly assumes an indifference to the error direction. Further, loss associated with the error is proportional to its size.

pattern given by ++-, then the analysts have failed to predict one turning point.

BC reported the following forecast errors averaged cross-sectionally by year over their 100 firm sample:

Table 3.1
Average Annual Forecast Error
As Reported by Barefield and Comiskey

Year	Average Forecast Error
1967	14.14%
1968	13.92
1969	13.31
1970	22.59
1971	18.26
1972	14.22
Average 1967-72	16.07%

They also reported average forecast errors by industry over the same period:

Table 3.2
Average Industry Forecast Error
As Reported By Barefield and Comiskey

Industry	Average Forecast Error
Utilities	4.49%
Banking	6.05
Drugs	7.71
Food/Beverage/Tobacco	8.45
Other	10.79
Chemical	15.29
Oil	19.93
Manufacturing	19.98
Transportation	32.96

The examination of turning point predictions produced the following results:

Table 3.3
Analysis of Turning Point Errors
As Reported by Barefield and Comiskey

		Predicted: Turning Point	Predicted: No Turning Point
Actual	Turning Point	a. 132	c. 67
Actual	No Turning Point	b. 37	d. 164

Cells (b) and (c) represent the two types of turning point errors: in (b), a turning point is predicted but none actually materializes, and in (c), a turning point does occur but was not forecast. The number of correct forecasts is the sum of (a) and (d) or a total of 296 out of 400.

Finally, BC compared the forecasts of analysts to the prediction of a naive, mechanical forecast. The naive forecast is a "no change" prediction, that is, $EPS_{t+1} = EPS_t$. Utilizing Theil's U-statistic,

$$U = \frac{\sum \left\{ (P_i - A_i)^2 \right\}^{1/2}}{\sum \left\{ A_i^2 \right\}^{1/2}}$$

where P_i is the <u>difference</u> of predicted EPS in year t and actual EPS in year t for company i, and A_i is the difference in actual EPS in year t-1 and year t for company i. Coefficient U approaches zero as a lower boundary when all predictions are correct, and U takes a value of unity when the performance of predictions is the same as the performance of the naive, no change model.

And U is greater than unity, when the predictions are less accurate than the naive, no change benchmark. Against the naive model, BC report the following distribution of computed U-values:

Table 3.4
Theil's U-Statistic
As Reported by Barefield and Comiskey

U-Value	Number of Companies
0 - .25	9
.26 - .50	22
.51 - .75	19
.76 - .99	18
1.00 - 1.25	16
1.26 - 1.50	4
>1.50	12
Total	100

Barefield and Comiskey conclude that the forecast errors of security analysts compare favorably with the forecast errors of management reported in other studies. They find the average forecast error of about 16 percent reported in their study to be about the same as the average 15 percent forecast error of managers reported by the Financial Analysts Federation in a 1973 study. BC also note that security analysts are very successful in forecasting earnings turning points, having accurately predicted the direction of change almost 75 percent of the time.

In comparisons against naive, "no change" predictions, security analysts' forecasts were more accurate for 68 out of the 100 companies sampled. They do acknowledge that the no change model is a weak standard of

comparison and that analyst forecasting performance might decline if more sophisticated, mechanical models were employed as a benchmark.

3.2.2 Basi, Carey, and Twark (1976)

Basi, Carey, and Twark (BCT) consider two questions of forecast accuracy:

1. How well does management forecast EPS?

2. What is the relative accuracy of security analysts' forecasts as compared to the forecasts of managers?

From the Wall Street Journal, BCT gathered annual earnings forecasts made by managers over the period 1970 to 1971. These forecasts were of four general types:

1. Point estimates of EPS.

2. Range estimates of EPS.

3. Point estimates of percentage increases or decreases from the previous year's earnings.

4. Range estimates of percentage increases or decreases from the previous year's earnings.

If the forecast was made in the form of a percentage change, BCT computed the dollar EPS forecast by applying the percentage to the prior year's EPS. If the forecasts were in the form of a range, BCT used the midpoint of the range as a point estimate. In order to construct a test of the comparative accuracy of managers and analysts, it was also required that analysts forecasts for the respective companies be available in the Standard and Poor's Earnings Forecaster. Following this procedure, BCT

were able to construct a sample of 88 firms having all necessary data.

The tests designed by BCT actually address four hypotheses regarding forecast accuracy:

1. Forecasts of EPS for utilities are more accurate than those for non-utilities.

2. Forecasts of EPS for New York Stock Exchange listed firms are more accurate than those for American Stock Exchange listed firms.[3]

3. Company (manager's) forecasts of EPS are more accurate than those of security analysts.

4. Forecast accuracy improves as the date of the forecast approaches the end of the accounting period when the actual results are computed.

In order to test these hypotheses, BCT utilize the following measures computed for both the managerial forecast and the analyst forecasts:

$$\text{Mean Percentage Error} = \frac{(\text{Forecast} - \text{Actual})}{\text{Actual}}$$

$$\text{Mean Absolute Percentage Error} = \frac{|\text{Forecast} - \text{Actual}|}{\text{Actual}}$$

$$\text{Mean Square Percentage Error} = \frac{(\text{Forecast} - \text{Actual})^2}{\text{Actual}}$$

By considering the simple mean percentage error, BCT are able to determine the average direction of the forecast error, and by considering the mean square error,

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[3]BCT believe that firms whose common stock is listed on the NYSE are larger and more mature and therefore inherently more forecastable than AMEX firms.

outliers are given proportionately more weight in the final analysis.

Average representative results of the BCT study are shown in the table below:

Table 3.5
Representative Forecast Errors
As Reported by Basi, Carey, and Twark

	Mean Percentage Error		Mean Absolute Percentage Error		Mean Squared Percentage Error	
	C	SA	C	SA	C	SA
Utilities	-.005	.003	.045	.052	-.009	.009
Non-Utilities	.095	.134	.131	.185	.072	.123
NYSE	.018	.029	.065	.088	.016	.025
AMEX	.211	.303	.231	.321	.172	.293
All Firms	.060	.088	.101	.138	.050	.083

Values under columns labeled C are the average errors of company forecasts and values under columns labeled SA are the average errors of security analysts' forecasts.

After computing the error values, BCT rank ordered the errors, and created cumulative distributions of the error values. Using the method of stochastic dominance, a forecast method was claimed to dominate (be more accurate) if its cumulative distribution function was never less than that of another, competing forecast method and was greater than the other method at at least one point. In order to determine if the distributional dominance is statistically significant, BCT employ the Kolmogorov-Smirnov two sample test. In general, BCT find that company forecasts are more accurate than those of

security analysts but the difference is not significant.

Finally, to test Hypothesis 4, BCT correlated the mean percentage errors with the length of time between the publication of the forecast and the reporting of actual results. They found that both company and security analysts' forecasts showed significantly smaller errors, the nearer to the actual reporting date the forecast was made. For example, the average correlation coefficient between the mean percentage error of company forecasts and the length of time until actual results were known was .275, which is statistically significant at the .001 level.

Basi, Carey, and Twark conclude that on average company forecasts were slightly better than security analysts' forecasts, both on the basis of size of average errors and stochastic dominance criteria. Further they find that both companies and security analysts forecasted EPS for utilities better than non-utilities, and NYSE listed firms better than AMEX listed firms.

3.2.3 Brown and Rozeff (1978)

Arguably the best and most up to date of the studies of security analysts' short-term forecasts, Brown and Rozeff (BR) examine the relative forecast accuracy of a sophisticated (but still mechanistic) Box-Jenkins time series model versus that of security analysts. As a

proxy for the average forecast of security analysts, BR use primarily the published forecasts of the <u>Value Line Investment Service</u>.

The BR study examines several forecast horizons. Their choice of horizons reflected considerations of (1) micro-level information obtained by security analysts often impacts earnings projections one to five quarters ahead, (2) the effects on corporate earnings of changes in fiscal and monetary policy often take six to eighteen months to wind through the economy, and (3) the available published forecasts are mainly for short horizons.

They chose to investigate point estimates of quarterly EPS for forecast horizons one to five quarters in advance, over the period 1972 to 1975. Specifically, they took forecasts at several points in time that were conditional on the knowledge of different sets of past results. For example, the for the year 1973, they investigated the following quarterly EPS forecasts:

Table 3.6
Specification of Forecast Horizons
As Employed by Brown and Rozeff

1 Quarter Ahead	2 Quarters Ahead	3 Quarters Ahead
$F(73Q1 \mid 72Q4)$	$F(73Q1 \mid 72Q3)$	
$F(73Q2 \mid 73Q1)$	$F(73Q2 \mid 72Q4)$	$F(73Q2 \mid 72Q3)$
$F(73Q3 \mid 73Q2)$	$F(73Q3 \mid 73Q1)$	$F(73Q3 \mid 72Q4)$
$F(73Q4 \mid 73Q3)$	$F(73Q4 \mid 73Q2)$	$F(73Q4 \mid 73Q1)$

4 Quarters Ahead	5 Quarters Ahead
$F(73Q3 \mid 72Q3)$	
$F(73Q4 \mid 72Q4)$	$F(73Q4 \mid 72Q3)$

Brown and Rozeff constructed a sample of fifty New York Stock Exchange firms with December 31 fiscal years

that had the necessary earnings forecast data published in Value Line. In addition to those constraints, it was also necessary to include only firms that had available, a published source of quarterly EPS for the period 1951 through 1972. This time series of historical data was necessary to implement the Box-Jenkins technique. Due to insufficient earnings data, utilities were excluded from the sample population.

In addition to the evaluation of quarterly forecasts, BR also investigated annual forecasts of EPS, where the annual forecasts were obtained by summing the four quarterly forecasts that were conditional on knowledge of the prior year's EPS. For example, the annual forecast for 1973 is the sum of F(73Q1|72Q4), F(73Q2|72Q4), F(73Q3|72Q4), and F(73Q4|72Q4).

The Box-Jenkins technique makes very efficient use of the available data. Under the Box-Jenkins procedures, BR estimated a different forecasting model for each of the fifty firms in their sample. In implementing Box-Jenkins, the analyst chooses a model structure from among numerous alternatives that satisfies one or more pre-determined diagnostic conditions such as the structural form with highest R-square, most significant t-statistics, and so forth. By making no *a priori* assumptions about the process that generates EPS, the Box-Jenkins approach subsumes autoregressive, moving average, and most other forms of ad hoc time series models used by other

researchers. In effect, the Box-Jenkins technique selects the best forecasting model available given the historical data utilized, or in other words, Box-Jenkins lets the data speak for itself.

As noted earlier, the source for security analysts' forecasts were the quarterly EPS forecasts of Value Line. The measurements of these forecasts were taken in a way that made the historical information set available to the security analyst approximately coincident with the data available to the Box-Jenkins forecast method.

To test the relative accuracy of the two forecast methods, BR employ the Wilcoxon Signed Ranks test. For each forecast period, forecast errors from each method are paired by company. The members of each pair are reduced to a single observation by taking the absolute differences in the paired errors. Next, these differences are assigned ranks from 1 to n according to the relative size of the difference. Then, dependent upon the sign of the actual difference in the errors, the rank is given the same sign. Finally, a test statistic is computed as,

$$T_t = \frac{\sum \text{Rank}_{i,t}}{\sum \text{Rank}_{i,t}{}^2} ,$$

where the ranks and the squared ranks are summed over all companies i for forecast horizon t.

For the sample size of fifty companies, the test statistic follows (approximately) a normal distribution,

thus the critical region can be read directly from a table of areas of the normal distribution. To reject the hypothesis that the Box-Jenkins forecasts are more accurate than _Value Line's_ forecasts requires a T-value greater than 2.326 at the .01 percent significance level and a T-value greater than 1.644 at the .05 percent significance level. Brown and Rozeff report the following T-values for the quarterly EPS forecasts:

Table 3.7
T-Values Associated with Forecast Errors
As Reported by Brown and Rozeff

Year	Forecast Horizon (Number of Quarters Ahead) 1	2	3	4	5
1972	1.75	2.51	4.09	3.93	3.11
1973	2.48	3.47	3.34	2.79	1.66
1974	1.16	-1.45	-1.04	-0.92	-2.20
1975	3.51	1.62	-0.22	0.08	0.45

In all, the _Value Line_ forecasts were more accurate in 16 of 20 comparisons, and statistical significance occurred in 11 of those 16.

For the annual forecasts, BR report Wilcoxon Signed Rank T-values of 3.45, 2.17, 0.61, and 1.28 for years 1972, 1973, 1974, and 1975, respectively. Thus, based on the BR analysis, _Value Line's_ forecasts were more accurate than the Box-Jenkins forecasts in each of the four years, and were significantly so in 2 of the four years.

Brown and Rozeff provide strong conclusions based on their analyses. The following tend to capture the essence of their conclusions:

> In summary, the evidence strongly favors the hypothesis that _Value Line_ consistently makes

> significantly better predictions than time series models. The statistically significant experiments overwhelmingly favor Value Line. In the remaining experiments the majority of the Wilcoxon tests also favor Value Line, providing additional support for the hypothesis of analyst superiority.
>
> If market earnings expectations are rational, it follows that the best available earnings forecasts should be used to measure market earnings expectations. Given rational market expectations, our evidence of analyst superiority over time series models means that analysts' forecasts should be used in studies of firm valuation [and] cost of capital . . . (Page 13)

3.2.4 Elton, Gruber, and Gultekin (1981)

While Brown and Rozeff constructed explicit hypotheses about forecast accuracy under the theory of rational expectations, Elton, Gruber, and Gultekin (EGG) examine the importance of expectations of EPS in the determination of share price. Implicitly, the study of EGG is more in keeping with the Keynesian beauty contest than rational expectations. That is, irrespective of forecast accuracy itself, EGG are concerned with determining the type of expectational data that has the greatest influence on share price. Or in their tests, the type of expectational data that if known to an individual could produce excess returns.

As acknowledged by EGG, the testing of EPS expectations on the determination of share price was not possible before the development of large, consistent data bases like the Institutional Brokers Estimate System (IBES). In Chapter Four, IBES is described in detail,

however at this point it is sufficient to say that the IBES data base utilized by EGG consisted of one-year-ahead and two-year-ahead EPS forecasts on virtually all New York Stock Exchange firms. The "consensus" forecasts reported in the IBES data base were the simple average of individual security analysts' forecasts. They restricted their sample to companies which had (1) December 31 fiscal years, (2) positive EPS in the years of the study, and (3) an IBES forecast which was the average of at least three individual security analysts' forecasts. Their final samples consisted of a total of 913 one year forecasts for the years 1973 to 1975, and 696 two year forecasts for the years 1974 to 1976.

Letting EPS_t stand for the actual earnings per share in year t, and CF_t stand for the consensus analyst forecast of earnings per share for year t, EGG defined five variables of interest to their study,

Actual Growth in EPS:	$G_t = (EPS_t - EPS_{t-1})/EPS_{t-1}$
Forecasted Growth in EPS:	$FG_t = (CF_t - EPS_{t-1})/EPS_{t-1}$
Differential Growth in EPS:	$DG_t = (G_t - FG_t)$
Forecast Error:	$M_t = (EPS_t - CF_t)$
Percentage Forecast Error:	$\%M_t = M_t / \lvert EPS_t \rvert$

Elton, Gruber, and Gultekin measure these variables for the one-year-ahead forecasts and results. They also measured forecast error and percentage forecast error for two-year-ahead forecasts and results (where t in the definitions should be replaced by t+1). In addition to the seven variables above, EGG also investigate the impact of forecast revisions on share prices. They define a

variable measuring forecast revision as $FR_t = [{}_{(t-a)}C_t - {}_{(t-a+12)}C_t] / {}_{(t-a+12)}C_t$. Note that FR_t measures the relative difference in the consensus forecast for year t made at time (t-a) and for forecasts for year t made twelve months later (t-a+12).

The IBES data are published monthly; however EGG restricted themselves to two forecast dates, March and September. March was selected as the earliest time in the new fiscal year when results from the prior fiscal year would be generally available. September was selected as a month that was far enough from the first forecast and far enough into the fiscal year that significant additional information on the company would be known, yet not so far that the actual results for the year would be known with certainty. For the two year forecasts, only the September data were used.

After measuring each variable for each time period (March and September) and for each year, all stocks were ranked on each variable and divided into deciles. For each decile, the simple average value of each variable was computed. Each decile group was also considered to be a equally weighted portfolio of the stocks comprising the decile.[4]

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[4]Note that there are a total of eight variables, the five one year measures, the two two year measures, and the measure of forecast revision. Thus, in total, there are eighty groupings, ten portfolios on each of eight variables.

Next, EGG computed risk adjusted excess returns for each portfolio (decile) using the standard market model,

$$r_{it} - (\hat{a_i} + \hat{B_i r_{mt}})$$

where r_{it} is the return on portfolio i in period t, a_i and B_i are the estimated parameters of the market model, and r_{mt} is the return on the market index (Standard and Poor's 500 index adjusted for dividends) for period t. The parameters were estimated using sixty months of historical data up to and including the month of the IBES forecast.

For each of the deciles for each of the variables, excess returns were computed for twenty-four months after the forecast month. And cumulative excess returns in each month were calculated as the sum of the current month's excess returns added to the sum of the prior months' excess returns on a going forward basis from the forecast month.

Finally, EGG computed correlation coefficients between the rank of the excess returns for each decile and the decile number. A significant positive rank correlation coefficient would be indicative of a relationship between that variable and measured excess returns. For brevity, EGG do not report all of their empirical results. They chose to group the deciles by top 30 percent, middle 40 percent, and lower 30 percent. They also chose to present comprehensive results for only

months 7 and 13 after the March forecast date, and month 7 after the September forecast date. The rank correlation coefficient results of their study are shown below.

Table 3.8
Rank Order Correlation Coefficients
As Reported by Elton, Gruber, and Gultekin

	Variable							
	G	FG	DG	M^{1Y}	$\%M^{1Y}$	M^{2Y}	$\%M^{2Y}$	FR
March(7)	.90*	-.35	.84*	.98*	.90*			
March(13)	.88*	-.30	.93*	.96*	.85*			
September	.53	.37	.95*	.95*	.89*	.96*	.98*	.83*

An * indicates significance at the .01 percent level.

The average cumulative excess returns for the upper three deciles (upper 30 percent of variable rankings) are shown below:

Table 3.9
Average Cumulative Excess Returns
As Reported by Elton, Gruber, and Gultekin

	Variable							
	G	FG	DG	M^{1Y}	$\%M^{1Y}$	M^{2Y}	$\%M^{2Y}$	FR
March(7)	.059	-.006	.077	.063	.071			
March(13)	.075	.001	.091	.072	.086			
September	.040	.013	.062	.057	.065	.077	.079	.089

Elton, Gruber, and Gultekin assess the roundtrip transactions cost of buying and selling a representative share at about .04, thus cumulative residuals in the table in excess of four percent would have economic significance as true excess returns.

From the study's results, EGG concluded that no discernible excess returns can be earned by selecting stocks on the basis of the consensus forecast of earnings growth (FG). In the three years that they studied, growth forecasts appear to be well incorporated into security prices.

However, knowledge of the actual growth rate (G) does apparently lead to excess returns. Investors with perfect forecasting ability could make risk adjusted excess returns by buying and selling securities on the basis of their superior knowledge. Even larger excess returns can be made by knowing both the consensus forecast and having the ability to accurately forecast actual growth. The top 30 percent for which differential growth (DG) was the largest also produced the largest average excess rate of return. Thus, according to EGG,

> What an investor desirous of making excess profits should be most concerned with is finding securities where his forecasts are not only good in the sense of being right but where they are both accurate and different from the consensus. (Page 985)

To paraphrase EGG, market participants utilize the forecasts of security analysts in forming their expectations about earnings, thus the consensus of analysts' forecasts appears to be well incorporated into the current price of a security. Therefore, to make excess profits it is necessary to know when the consensus expectation is wrong by having a personal forecasting

model that is more accurate than that utilized by the consensus.

3.2.5 Other Studies

The late nineteen sixties and early seventies saw an effort by the Securities and Exchange Commission (SEC) to require companies that were marketing new security issues or companies with speculative security issues outstanding to disclose publicly forecasts of future earnings that had been prepared for internal management purposes. The SEC had also indicated that in the future it would require all companies with outstanding securities under its purview to file forecasts of future earnings. The managements of many companies feared that public disclosure of data that contained many speculative assumptions and uncertainties would lead to large scale stockholder litigation, especially when realizations of earnings turned out differently from the forecasts. The external auditors of these firms were also concerned about their ability to validate the forecast assumptions and results, and to ultimately certify the quality of the forecasts in any public disclosure. On the other side, the SEC, as it is today, was concerned with unfair dissemination of the forecast data to insiders, who could profitability exploit the information at the expense of the general investing public.

The ensuing public debate over adoption of the SEC's proposal instigated substantial research into the forecasting abilities of managers. At the same time, a counter proposal emerged that was based on the claim that security analysts' forecasts were just as good as those of managers. The thrust of this proposal was that public disclosure of the forecasts of managers was unnecessary because the forecasting function was already being fulfilled adequately by security analysts. Thus, in addition to the tests of management forecast accuracy, there also emerged a large body of tests of the accuracy of security analysts' forecasts, and comparisons of the forecasting ability of management versus security analysts. Table 3.10 summarizes most of those studies by indicating the purpose, method, and result.

As shown in the table, the results were decidedly mixed about management's forecast ability. However, the results regarding security analysts' forecasts generally support the view of analysts' forecast superiority. None of the studies indicated that security analysts' forecasts were dominated by either the mechanical models or the forecasts of management. Elton and Gruber (1972) is the only study which indicates equivalent forecasting performance between naive models and the analysts. Their results, however, should be re-examined in light of their 1981 study that was reviewed in the previous section.

TABLE 3.10
Other Studies of Short-term Forecast Accuracy

Study	Purpose	Methods	Results
Green and Segal (1967)	Accuracy of management forecasts	a.WSJ b.1963-64 c.APFE	Large forecast errors, forecast unreliable.
Klepczynski (1971)	Accuracy of analysts forecasts vs. naive models	a.S&P b.1966-68 c.APFE	Analysts outperformed naive models.
Stewart (1973)	Accuracy of analysts forecasts	a.Direct b.1972 c.APFE	Analysts are relatively accurate, notes optimistic bias
Copeland and Marioni (1972)	Accuracy of management forecasts of naive models	a.WSJ b.1968 c.APFE	Executives appear to be proficient at forecasting.
Crichfield, Dyckman, and Lakonishok (1978)	Accuracy of analysts forecasts vs. mechanical models	a.S&P b.1967-76 c.Theil's U	Analysts forecasts outperformed naive models.
Elton and Gruber (1972)	Accuracy of analysts forecasts vs. mechanical models	a.Direct b.1962-67 c.MSE	Mechanical models produce forecasts as good as analysts.
Lorek, McDonald and Patz (1976)	Comparison of management forecasts vs. Box-Jenkins forecasts	a.WSJ b.1966-70 c.RPE, WSR	Box-Jenkins technique superior to management forecasts.
Ruland (1978)	Accuracy of management forecasts vs. analysts' forecasts	a.WSJ, S&P b.1969-73 c.APFE	Management and analyst accuracy about the same.

Notes: a. The source of forecast data; WSJ is Wall Street Journal, S&P is Standard & Poor's Earning Forecaster, and Direct is gathered directly from analysts. b. The study period. c. The measure of forecast accuracy; APFE is the absolute percentage forecast error, RPE is relative percentage forecast error, and WSR is the Wilcoxon Signed Ranks test.

The four primary studies that were summarized in this section address the question of the relevance of security analysts' forecasts in several different ways. Under either an implicit or explicit hypothesis of rational expectations, Barefield and Comiskey, Basi, Carey, and Twark, and Brown and Rozeff all found that security analysts' forecasts of short horizon EPS were at least as accurate as the forecasts of management or forecasts made by extrapolating historical accounting data. Elton, Gruber, and Gultekin found that knowledge of the consensus of security analysts' forecast did not lead to excess security returns but that knowledge of when the consensus forecast was incorrect did. Thus, their examination provides strong evidence that the consensus of security analysts' forecasts <u>is</u> utilized by investors in the formation of their expectations.

However, it would be incorrect to immediately infer that security analysts' long-term forecasts of earnings or growth are equally accurate or equally as important in the formation of investor expectations.

<u>3.3 The Empirical Literature on Security Analysts' Long-term Forecasts</u>

<u>3.3.1 Cragg and Malkiel (1968)</u>

The seminal study of security analysts' forecasts of long-term growth is that of Cragg and Malkiel (CM1). They were able to obtain the forecast of earnings growth for 185 companies. These forecasts were obtained directly

from five investment firms that participated in the Institute for Quantitative Research in Finance (commonly known as the Q-Group) or the New York Society of Security Analysts. The five investment firms were comprised of two commercial banks, one investment bank, one mutual fund management firm, and one brokerage firm. Cragg and Malkiel assume that it is reasonable to believe that these firms are representative not only of the opinions of large professional investment institutions but also proxy well for more general investment opinions.

The forecasts were in the form of average annual growth rates expected to occur over the next five years. Based on conversations with the respective analysts, CM1 find that these growth rates should be regarded as "parameters" of the process determining expected future earnings. That is, analysts attempt to normalize their earnings growth forecast by adjusting for idiosyncratic or cyclical effects and non-recurring shocks, and by making the earnings growth forecast as independent as possible from a particular base year. The forecasted growth rates were provided as single numbers for each corporation, without any additional information on the analysts' confidence about the point estimate. Two forecasts, one made at the end of 1962 and the other made at the end of 1963, were obtained from each analyst.

The first examination of CM1 was to determine the agreement among the analyst forecasts. This was done by

computing simple correlation coefficients and Spearman rank correlation coefficients between the forecasts of the five investment firms, and the Kendall coefficient of concordance across the entire set of forecasts.[5] The simple correlation coefficients ranged from .563 to .889 for 1962 forecasts and .537 to .889 for the 1963 forecasts. The Spearman rank correlations ranged from .388 to .768 and .374 to .821 for the 1962 and 1963 forecasts, respectively. The Kendall coefficient of concordance was .79 and .87 for 1962 and 1963, respectively. From these analyses, CM1 find that while the analysts forecast display considerable agreement the amount of disagreement is not negligible, with one analyst showing systematically different results from the other four.

The relatively high correlations could have been caused by analyst agreement about the future earnings of an industry as opposed to agreement about specifics for particular companies. Cragg and Malkiel investigate this possibility by decomposing the correlation coefficients

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[5]Kendall's coefficient of concordance is given by:

$$W = \frac{12}{b^2k(k+1)(k-1)} \sum[R_j - \frac{b(k+1)^2}{2}]$$

Where in this case, b is the number of different companies (185), k is the number of forecast agents (5), and Rj is the sum of the rankings for each forecast agent j across all intracompany comparisons. W will be close to unity for strong agreement and close to zero for strong disagreement. See, for example, Conover (1980).

for individual company forecasts into correlations within industries and the correlations between forecasts of industry average growth. They find that little of the overall agreement is due to a consensus view of industry averages. They also find that the agreement about industry averages varies with the industry, the correlations tended to be lowest in the oil and cyclical industry firms, and highest for electric utility companies.

The next examination of CM1 concerned the associations of analyst growth forecasts with historical growth rates. Because no a priori reasoning can be invoked to determine the particular historical period that should be associated with a forecast, CM1 examine the correlations of forecasts with numerous historical periods and methods of computing the historical growth rates in those periods. For both the 1962 and 1963 forecasts, the highest average correlation coefficients were exhibited by point to point growth rates and growth rates computed as a log linear regression of earnings against a time index. In each case, the most recent ten year period of time produced the highest correlations. The average level of the coefficients was about .65. The pattern of correlations of the various analysts forecasts with historical growth rates suggested to CM1 that the agreement among security analysts found earlier was primarily attributable to their common use of historical

information. Thus, while analysts apparently start from the same basic information set, CM1 conclude that the actual forecasts are made using very individual methods.

Another examination contained in CM1 is a comparison of growth forecasts to the price-earnings ratios (P/E) of the respective stocks. They claim that it is possible to utilize a normative valuation model (e.g., discounted cash flow) to infer the market's expectation of growth and, therefore, comparisons of P/E with forecasts of growth may be interpreted as examinations of the relationships between the forecast and market-based expectations.[6] In computing the P/Es, they used closing stock prices for the last trading day of the year and two different measures of earnings. The first measure was the actual EPS for the year. The second measure was the normalized or "trend" earnings figure supplied by the security analysts. As it turned out, the correlations of forecasts with either measure of P/E were of about the same level. The correlations for four of the five analysts were about the

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[6]While not explicitly set forth, CM1 apparently have in mind the following. Given that $P_0 = D_1/(k-g)$, dividing both sides by EPS, yields $(P_0/EPS) = (D_1/EPS)(1/(k-g))$. For a given payout ratio, (D_1/EPS) and given discount rate, k, with $k > g$, a positive change in growth, g, will bring about a positive change in the P/E, (P_0/EPS),

$$d(P_0/EPS) / dg = [(k-g)+(D_1/EPS)] / (k-g)^2.$$

CM1 would, therefore, expect to find a positive correlation between the growth forecasts and the P/E if the security analysts' forecasts are used by market participants in forming expectations.

same, on average .8 for 1962 and .78 for 1963. The correlation with the fifth analyst was somewhat poorer, .55 for 1962 and .64 for 1963.

The final examination contained in CM1 was an assessment of forecast errors. Although the forecasts were made for the average annual growth over the next five years, those five years had not yet elapsed at the time the study was written. Cragg and Malkiel measured forecast errors as the difference between the forecast value for 1962 and 1963, and the actual annual growth that occurred over the three year period, 1962 to 1965, and over the two year period, 1963 to 1965, respectively. They computed Theil's U-statistic, for each analyst and for several predictions of growth made by extrapolating historical data. That is, both security analysts' forecasts and naive growth estimates were compared to a no change prediction. The U-statistics are reported below:

Table 3.11
Theil's U-Statistic
As Reported by Cragg and Malkiel

	Analyst					Historical Method@			
Period	A	B	C	D	E	1	2	3	4
1962-1965	.80	.78	.57	.67	*	.74	.88	.74	.78
1963-1965	.85	.84	.59	.73	.81	.78	.75	.77	.62

An * indicates insufficient data.

@Historical method 1 is the trended growth for the most recent 10 years, method 2 is the trended growth for the most recent 5 year period, method 3 is six year point to point growth, and method 4 is the change in annual earnings for the most recent year.

Recall that values of the statistic close to zero indicate accurate predictions, values close to one indicate forecast performance equivalent to the "no change" benchmark, and values greater than one indicate forecasting performance that is poorer than the benchmark. CM1 conclude that analyst forecasting performance is only slightly better than the "no change" benchmark, and that growth prediction based on historical trends is no worse than the analysts' predictions. Although Analyst C indicated some relative superiority, CM1 claim that this is illusory because the majority of C's forecasts were concentrated on large, relatively stable companies.

Cragg and Malkiel summarize their findings as follows:

> The remarkable conclusion of the present study is that the careful estimates of the security analysts participating in our survey, the bases of which are not limited to public information, perform little better than these past growth rates. (Page 610)

3.3.2 Malkiel and Cragg (1970)

This paper can be viewed as an extension of CM1. Its purpose was to determine if the use of expectational data improved the explanatory power of a linear regression model that related stock prices (and P/Es) to such factors as growth, dividend payout, and various proxy measures for risk.

The expectational data gathered by Malkiel and Cragg (MC) consisted of long-term (5 year) earnings growth

forecasts, forecasts of the next year's EPS, and expectations about the future variability of earnings on 178 corporations. The data points were forecasts made at year-end for the years 1961 through 1965. The forecast data was provided by seventeen investment firms that were members of the Institute for Quantitative Research in Finance. Not all of the investment firms provided forecasts for each of the 178 companies in every year, and to some extent the sample companies were concentrated in the "blue-chip" category.

The empirical model utilized by MC in their study is derived from the basic, constant growth, discounted cash flow model. Beginning with

$$P_0 = \frac{D_0(1 + g)}{(k - g)} ,$$

and dividing both sides by earnings, E, yields

$$\frac{P_0}{E} = \frac{D_0}{E} \; \frac{(1 + g)}{(k - g)} .$$

In this form, P/E is a function of the dividend payout ratio, the required rate of return, and expected growth. MC note that the model is non-linear in growth, but decide to employ a linear approximation for estimating the parameters. The assumption of linearity is probably reasonable over a relevant range of variable values, although systematic differences among industries may cause the model to offer "better" explanatory power for some firms.

Figure 3.1 plots the relationship between P/E and growth for several levels of payout ratios while holding the required return constant at .15. As shown, the relationship is close to linear for low values of growth but becomes less linear as the growth rate increases or at higher levels of the payout ratio.[7]

Because the rate of return (k) is not observable, MC used various risk proxy measures as instruments for k, including models employing (1) betas, (2) deviations of historical earnings about a trend line and analysts expectations about earnings fluctuations (stability), and (3) financial leverage ratios. The final form of the general empirical model is given by

$$\frac{P}{E} = \hat{a}_0 + \hat{a}_1 \text{ [Growth]} + \hat{a}_2 \text{ [Payout Ratio]} + \hat{a}_3 \text{ [Risk 1]}$$
$$. \; . \; . + \hat{a}_n \text{ [Risk m]}.$$

In addition to the expectational measure of growth that utilizes security analysts' forecasts, MC also estimated the model parameters by using a measure of historical growth obtained by computing the average annual change in earnings over the most recent 10 year period. The payout ratio was also measured in two ways, (1) the most recently reported dividend per share divided by a

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[7]The non-linearity should be accounted for in statistical tests of significance by correcting the residuals for heteroskedasticity.

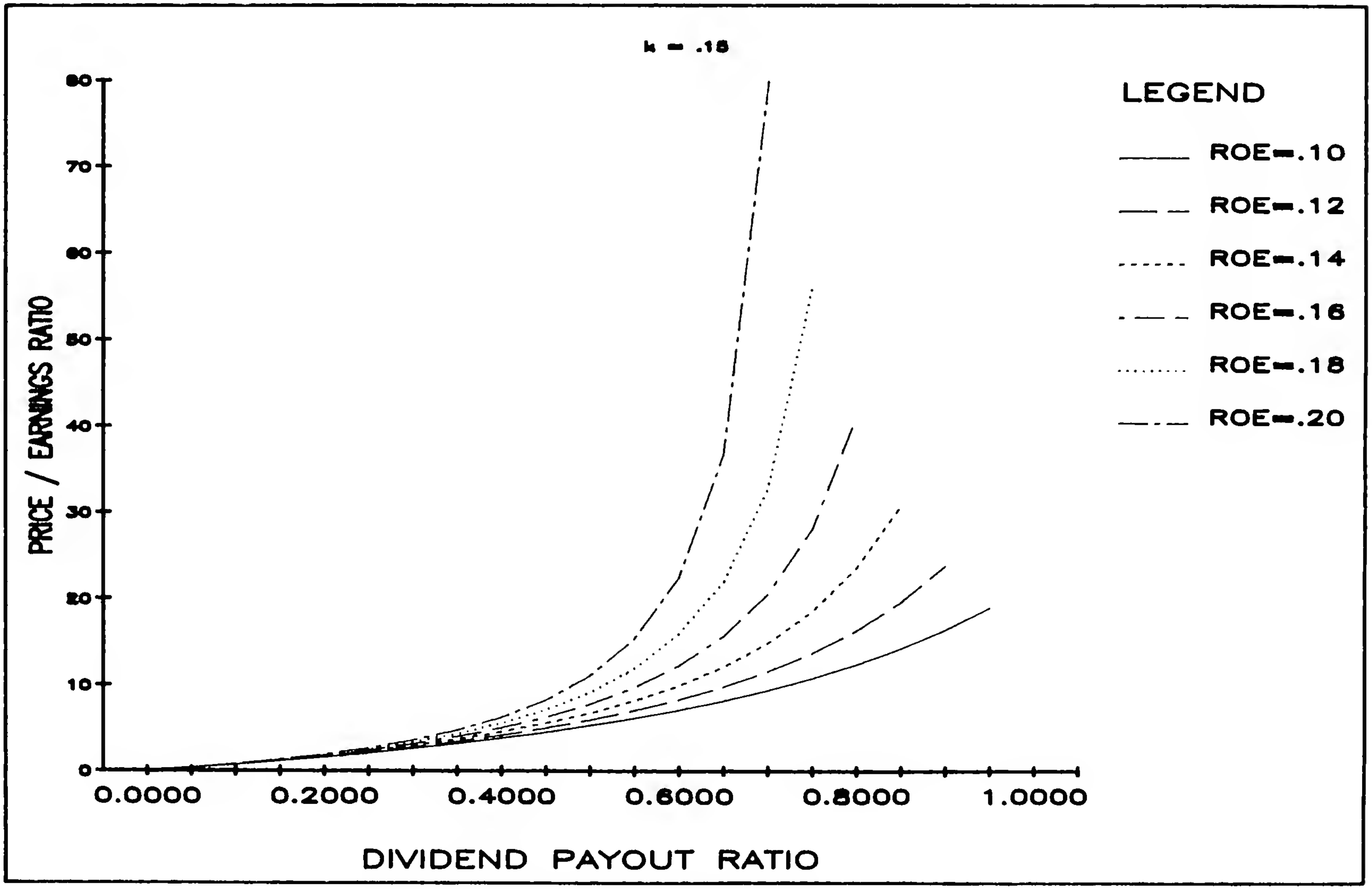

Figure 3.1
Relationship of Price Earnings Ratios to Growth and Dividend Payout
As Predicted by the Discounted Cash Flow Model

forecast of normalized earnings per share, and (2) the average payout ratio over the preceding seven years.

Malkiel and Cragg first established a benchmark model by estimating the parameters using only historical data. Then the same form of the model was estimated using expectational data where appropriate. Comparison results for 1965 are shown below.

Table 3.12
Regression Results
As Reported by Malkiel and Cragg

	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	R^2	F
		Growth	Payout	Stability		
Historical:						
	5.74	1.52	6.64	0.35	.65	98.65
Std. Error		.10	3.55	.77		
t-statistic		15.23	1.87	.46		
Expectational:						
	0.96	2.74	5.01	-0.35	.85	317.52
Std. Error		.10	2.05	.35		
t-statistic		26.50	2.44	-1.14		

As shown above the fit was better for the model using the expectational data. Across the five year study period, the average R^2 for the historically based model was .49 versus an average value of .75 for the expectationally based model. The signs of the estimated coefficients were as expected for both models.[8]

Malkiel and Cragg estimate the model under several specifications of the risk variables and combinations of

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[8] Although the results are not reported, MC also note that the use of the average "consensus" forecast of all analysts provided much better statistics than the forecast of any single analyst.

expectational and historical data. The best model fit in terms of average R^2 (adjusted for degrees of freedom) across all years of the study period was,

$$\frac{P}{E} = \hat{a}_0+\hat{a}_1[GROWTH_{SAF}]+\hat{a}_2[\frac{E_{t+1}}{NE}]+\hat{a}_3[\frac{D}{NE}]+\hat{a}_4[STABILITY_{SAF}],$$

where the growth and stability variables were measured directly as security analysts' forecasts. The expected earnings per share (E_{t+1}) and normalized expected earnings (NE) were also based on security analysts' forecasts. Thus, the best model was fit entirely using expectational data. As an example, the estimated parameter values and associated statistics for 1965 were:

Table 3.13
Estimated Parameter Values
As Reported by Malkiel and Cragg

	$\hat{a}0$	$\hat{a}1$	$\hat{a}2$	$\hat{a}3$	$\hat{a}4$
	-11.15	2.42	13.78	4.22	-0.81
Std. Error		0.12	1.85	2.34	0.38
t-statistic		19.59	7.46	1.81	-2.14

R^2 .83
F 162.61

Malkiel and Cragg concluded that it is possible to explain a very large percentage of the variability in market price earnings ratios with the expectational data used in their model, although they uncertain that security analysts form their expectations independently of the observed P/Es. In other words, it is possible that security analysts observing high market valuations of earnings adjust their growth forecasts and associated EPS

forecasts upwards to a level that rationalizes the high P/Es.

3.3.3 Cragg and Malkiel (1982)

Cragg and Malkiel (CM2) investigate a number of interrelated questions about the formation of expectations and the pricing of capital assets. Their objective was to develop and test realistic models of common stock prices and returns based on expectations actually held by market participants. As such it was necessary for CM2 to construct a unique body of expectational data, building off of the data collected in CM1. Their work, both the methodology and findings, forms the point of departure for almost all subsequent investigations of security analysts' long-term growth forecasts.

Cragg and Malkiel utilize two types of forecasts of expected growth rates, short-term (for the following year) and long-term. The long-term growth rate forecasts were furnished by nine securities firms for 175 companies chosen strictly on the basis of data availability. Each long-term growth forecast was reported by the analysts as an average annual rate of growth expected to occur in earnings in the next five years. In response to criticism regarding the particular relevance to expectation formations of five year forecasts, CM2 stated,

> At first thought, such a rate of growth depends on what earnings are expected to be in five years' time and on the base-year earnings figures. However, this dependence need not be

> very great if the growth rate is regarded more as a parameter of the process determining earnings than as an arithmetic quantity linking the current level of earnings to the expected future level. Discussion with the suppliers of the data indicated that all firms were attempting to predict the same future figure, the long-run average ("normalized") earnings level, abstracting from cyclical or special circumstances. (Page 17)

Interpreting the long-term growth forecasts in this manner suggests an immediate usefulness for the forecasts as inputs to the discounted cash flow approach to stock valuation. In turn, as in their earlier work, CM2 exploit this valuation model for their empirical studies. That is, starting from the observation that the random gross return for an investment in stock j as viewed from time t will be the (random) dividend received during the next period plus the (random) price at which the stock can be sold at the end of the next period, or

$$\tilde{r}_{j,t} = \tilde{d}_{j,t+1} + \tilde{P}_{j,t+1},$$

so that the expectation, $e_{j,t}$, is given by

$$e_{j,t} = E(\tilde{r}_{j,t}) = E(\tilde{d}_{j,t+1}) + E(\tilde{P}_{j,t+1}). \quad \text{(CM2 Eq.3.3-2)}$$

Next, CM2 make the following claim about the determination of security prices,

$$P_j = e_j a_0 + \sum c_{j,k} a_k, \quad \text{(CM2 Eq.3.2-9)}$$

where the a_k are the (few in number) common factors that are important in the determination of any security's risk, and the $c_{j,k}$ are coefficients representing the jth security's particular sensitivity to the common

factors.[9] Combining the two equations provides an expression for the expected return, $e_{j,t}$, as

$$e_{j,t} = E(\tilde{d}_{j,t+1}) + E(e_{j,t+1}a_{0,t+1} + c_{j,k,t+1}a_{k,t+1}),$$

and repeated substitution of the equation into itself and adoption of the assumption that the expected value of the sensitivity coefficients and the common factors is constant through time leads to an expression for the expected rate of return at time zero of

$$e_{j,0} = a_{0,t}E(\tilde{d}_{j,t+1}) = \sum a_{0,t} \sum a_k c_{j,k}.$$

This expression indicates that the determination of the expected rate of return depends on the time path of dividends, or in other words, the way in which dividends are expected to grow through time. The time path of dividends, in turn, can also be expressed as a function of the future revelations of the common risk factors. The model suggests that the factors reflect any systematic influences that affect dividends or earnings of firms and their growth prospects as well as the factor influence on future discount rates.

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[9]This model is derived in CM2. The resulting equation for the determination of security prices is the same as in the Arbitrage Pricing Theory (APT). However, rather than invoking directly the no arbitrage condition used in the APT derivation, CM2 assume that investors are well diversified across securities and that there is a large overlap of securities among the holdings of individual investors. This assumption leads to a conclusion that the market price of risk, a_k, attendant with risk factor c_{jk}, must be the same for all investors.

Next, CM2 assume that dividends grow at a constant rate g. Further noting that an implication of the factor model is that $a_0 = 1/(1+R_f)$, allows substitution of the above expression back into Equation 3.2-9 which yields,

$$P_{j,0} = d_{j,0} \sum(1+g_j)^t / (1+R_f)^t + (\sum \sum a_k c_{j,k}) / (1+R_f)$$

$$= d_{j,0}(1+g_j) / (R_f - g_j) + [\sum a_k c_{j,k}(1+R_f)] / (1+R_f)$$

Note that this expression is very similar to the constant growth discounted cash flow model with one important exception, the factors that contribute to riskiness of the security and its growth prospects are identified separately in the second term on the right hand side. This is distinct from the more common form of that model that is attributable to Gordon, where the risk adjusted discount rate contains and subsumes all risk factors that are priced by market participants.

However, as is also true for the Arbitrage Pricing Model, the model of CM2 offers no guidance in associating any particular economic phenomena to the risk factors. Thus, identification and measurement of the appropriate factors necessary to the testing of the valuation model is subjective. In order to explore the empirical content of their model, CM2 had to first identify risk factors by exploring relationships between security returns and some economic variables that they claimed to be of interest to any valuation model.

The first set of risk factors to be utilized in evaluating their model included the estimated covariance

of ex post rates of return on individual securities with the CRSP (Center for Research in Security Prices) value weighted index, or as they are more generally termed, empirical "beta" coefficients. Cragg and Malkiel also selected three additional indices of economic interest and computed the regression coefficients (correlations) of the individual security's ex post returns with these indices. These include the security's return correlations with (1) the rate of change in National Income, (2) the interest rate on ninety-day Treasury Bills, and (3) the rate of inflation measured by the increase in the Consumer Price Index. In an interesting departure from the standard procedures for this type of study, CM2 used a time series of observations for estimating the correlations that includes periods both before and after the valuation date. They used quarterly observations that covered periods three years before the valuation date and seven years following it. While not reported, they also state that variations in this procedure did not produce significantly different results, although R^2 coefficients for the final valuation results were improved by utilizing correlations estimated with future period data as opposed to utilizing only historical period data.

The second set of risk factors was more firm specific in nature. These included the variance about the mean of the security analysts' forecasts of long-term growth. According to CM2, this variance may be taken to be

indicative of the extent of uncertainty about the future rate of growth of the company, which may also be related to the uncertainty about future earned rates of return for the company.[10] In addition to the variance of the growth forecasts, CM2 also include the estimated residual variances from the regression of the ex post return series on the complete set of the four explanatory variables that produced the correlations described above. This measure, excepting for possible errors in variables problems, is most commonly interpreted as representing the firm's idiosyncratic risk. Finally, CM2 include the variance about the mean analyst forecast of short-term (one-year-ahead) earnings growth as an additional possible risk factor.

Cragg and Malkiel test their valuation model in several different stages and types of examinations. The first examination is designed to measure the importance of the risk factors on the expected rate of return of the security and to provide the empirical structure that is

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[10]While CM2 are most likely correct in their interpretation of the firm specific nature of variance of the growth forecasts, it is also possible that disagreement among the analysts' growth forecasts may also stem from disagreement in the individual predictions of the relevant economy wide influences on earnings, dividends and cash flows. That is, differences in predictions about the expected values of the common factors influencing growth. If this type of disagreement dominates the difference in forecasts, then the variance of the growth forecasts may also be interpreted as measuring elements of systematic as well as firm specific risk.

necessary for the actual implementation and testing of the valuation model. They measure the expected rate of return q for security j at time t as

$$\bar{q}_{j,t} = g_{j,t} + \frac{D_{j,t+1}}{P_{j,t}} ,$$

where $g_{j,t}$ is the simple average of the individual security analyst's forecast of long-term growth made at time t for security j. $D_{j,t+1}$ is the expected dividend per share to be paid during the next year. This value was measured by using the forecasted amount furnished by one of the group of security analysts who had provided the long-term growth forecasts. The stock price, $P_{j,t}$ was measured as the year end closing price. They perform simple regressions of the expected return measure on each of the previously measured risk factors of the form

$$\bar{q}_{j,t} = a_0 + a_1[\text{Risk Factor}_k] + e_{j,t}$$

for each of the years, 1961 through 1968. The average, asymptotic t-statistics over the entire period are reported below.

Table 3.14
Asymptotic t-Statistics
As Reported by Cragg and Malkiel

MARKET	GNP	T-BILL	CPI	VAR(g-LT)	VAR(error)	VAR(g-ST)
2.87	1.85	-1.97	-2.12	4.05	1.58	-0.24

As would be expected, certain of the explanatory variables exhibited multicollinearity, thus the most efficient structure of the relationship did not include

all of the risk variables. Cragg and Malkiel investigated this by performing factor analysis on the variance-covariance matrix of the regression coefficients used as risk measures. The factor analytic approach suggested that at most only two factors were required to explain the variances of the regression coefficients. Using this information, CM2 adopted a trial-and-error approach to determine the particular combination of risk measures that produced the best fitting regression results. Their final model, chosen on the basis of largest R^2 coefficients and year to year consistency in the estimated parameters is given below:

$$\bar{q}_{j,t} = \hat{a}_{0,t} + \hat{a}_{1,t}[CPI_{j,t}] + \hat{a}_{2,t}[Var(g\text{-}LT)_{j,t}] \text{ .}$$

In their words,

> The results suggest that at least two factors are relevant in valuation. One may be equated broadly to inflation and its associated effects. The other, possibly representing market risk, seems to be better represented by the variance of the predictions of long-term growth than by any of the regression coefficients. (Page 164)

Cragg and Malkiel also returned to the model utilized in their earlier work (1968 and 1970), and re-examined those empirical relationships using the risk measures described above. This model is the linear approximation to the discounted cash flow model with both stock price and dividends normalized to earnings, and extended to incorporate specific risk variables,

$$\frac{P}{NE} = \hat{a}_0 + \hat{a}_1[g_p] + \hat{a}_2[\frac{D}{NE}] + \hat{a}_3[Risk]$$

In trying the different specifications incorporating the various risk measures, CM2 found that the regression coefficients based on the risk measures of covariance with CRSP market index and the change in GNP had the appropriate signs but that the associated t-statistics were only occasionally significant. The regression coefficients associated with risk measures of covariance with the change in the CPI and the Treasury Bill rate were significant toward the end of the study period but were generally signed incorrectly. However, as before, the regression coefficient associated with the risk measure of the variance about the mean long-term growth forecast was highly significant, consistent in value, and properly signed.

The finding that the cross-sectional structure of price earnings ratios is linearly related to the distribution of analysts growth forecasts and that the dispersion of those forecasts also helps to explain the distribution of price earnings ratios are important results from the standpoint that they strongly suggest that investors utilize security analysts' forecasts in forming their own expectations. Yet, while the CM2 research established an empirical link between stock prices and security analysts' forecasts, the results have been questioned due to the small number of analysts

forecasts and companies relied upon in the study. Further, the CM2 results were based on data observations before the extreme upheavals in the financial markets and information service industry that occurred during the 1970s and 1980s when institutional investors became a much more dominant force in those markets. In Chapters Four and Five, a much broader data base of wider and more recent coverage is introduced and examined as an update to the Cragg and Malkiel research.

CHAPTER FOUR

AN INTRODUCTION TO THE DATA

4.1 Overview

From the preceding review of the empirical literature, it is clear that the vast majority of the earlier studies of security analysts' short-term forecasts were based on limited data sources. Many of these studies relied on data collection methods that were not reproducible by subsequent researchers, which in turn reduced the potential for additional analysis and rendered the early results almost unverifiable. Rigorous testing of expectational data on earnings per share forecasts did not take place until standardized, well maintained and publicly available data bases came into existence.

This deficiency is even more pronounced in the few existing studies of security analysts' long-term growth forecasts, where consistent and generally available sources of expectational data were not being maintained before the early work of Cragg and Malkiel. It was the early studies of Cragg and Malkiel, and their interaction with the investment community and especially their relationship with the Institute for Quantitative Research in Finance that led to the development of a data base devoted exclusively to expectational and forecast data.

This data base was maintained originally at Princeton University, but later grew into a proprietary service called the Institutional Brokers Estimate System (IBES) that is now managed by the Wall Street firm of Lynch, Jones and Ryan. Lynch, Jones and Ryan expanded the coverage of companies and the number of security analysts being surveyed for input and originally marketed the service as a source of consensus forecasts of one-year-ahead and two-year-ahead EPS estimates. In late 1981, Lynch, Jones and Ryan added the collection of security analysts' forecasts of long-term growth to the data system, and in January 1982 the first standardized, consensus forecast of long-term growth was made available on a monthly basis in machine readable format.[1]

The long-term growth data are reported in summary statistic form as the mean, median, high, and low forecasts of the expected annual rate of growth in earnings per share over the next five years. The analysts who participate in furnishing the forecast data

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[1]The IBES long-term growth data has been maintained continuously since January 1982. A historical time series of monthly summary statistics such as the mean forecast, median forecast, highest forecast, lowest forecast, and standard deviation of the forecasts is available from Lynch, Jones and Ryan or through resell systems such as Interactive Data Corporation, Chase Econometrics and Lotus One Source. According to correspondence with IBES officials, the detail of individual forecasts is not consistently available for all historical periods due to a computer systems change. A data service similar to IBES, known as Zack's Investment Research, is now offered through Standard and Poor's Compustat system.

> include all of the 300 investment professionals who were voted the nation's most outstanding in 1984 by over 500 leading financial institutions surveyed for the Institutional Investor's 'All-American Research Team.' (Letter from Mr. Dale Berman, Lynch, Jones and Ryan, January 15, 1985.)

As of February 1987, the IBES service provided forecast data on about 3,000 corporations with equity securities traded in U.S. markets, representing the forecasts of over 2,000 security analysts from about 100 stock brokerage houses. (Appendix 1 contains a list of participating brokerage houses.) According to Lynch, Jones and Ryan, subscribers to IBES include "the 100 largest financial institutions in the U.S." (Letter from Mr. Dale Berman, Lynch, Jones and Ryan, January 15, 1985.) In addition, many smaller investment organizations subscribe to IBES directly or through various time-sharing systems. An informal telephone survey of investment and portfolio managers for the trust departments of fifty commercial banks in Florida, New Jersey, and New York indicated that about ninety percent of those institutions also obtain IBES or a similar service on a regular basis. Thus, it is reasonably well documented that the IBES service is representative of the total universe of security analysts and that the service is in use by both small and large institutional investors.

For the conduct of this research, two different sample compositions and time frames of IBES data were obtained. The high cost of accessing IBES data for

historical periods prevented total global analysis. The IBES data available for analysis consists of the following:

1. Summary statistic data for the long-term (five year) growth forecasts on 1813 firms made in January 1982. This consists of the mean forecast (MNIBES), the median of the forecasts (MDIBES), the high forecast (HIIBES), the low forecast (LOIBES), the number of forecast agents (NIBES), and the standard deviation about the mean forecast (SDIBES). This data will be used to assess the forecast errors against the actual outcomes for earnings and dividend growth over the five year period January 1982 through December 1986. This analysis represents the first known test of the forecast accuracy of the IBES long-term consensus data.

2. Summary statistic data for the long-term (five year) growth forecasts on 155 regulated utilities made in each month for each year 1982 through 1986. Again, this consists of the mean forecast, the median of the forecasts, the high forecast, the low forecast, the number of forecast agents, and the standard deviation about the mean forecast. This data will be used to assess the informational efficiency of security analysts' forecasts vis-à-vis naive methods of historical trending.

To complement the expectational data and provide the accounting information necessary for the computation of actual growth rates and for use in developing historical

growth rate values, the Compustat data service was employed. The Compustat data base that was available consisted of twenty years (through the third quarter of 1986) of accounting statement information for the population of companies known as the Primary, Supplementary, and Tertiary Industrial File. This population consists of all companies with common stock listed on the New York Stock Exchange, most companies with common stock listed on the American Stock Exchange, and many of the larger companies that have equities traded over the counter. The Compustat data was augmented for the fourth quarter of 1986 through access to the Prices Data Base of Interactive Data Corporation, which provides real time data on earnings per share, dividends per share, and stock prices.

In addition to the expectational data obtained from IBES, a comparative sample of five-year-ahead earnings per share and dividend per share forecasts made by Value Line in the first quarter of 1982 were also obtained. The companies represented in this sample include 130 regulated utility companies followed by Value Line. The Value Line data will be used as an independent forecast of expected growth, although Value Line is also a contributor to the IBES data base.

The study proceeds in the following manner. In Section 4.2, alternative methods of extrapolating future growth from historical accounting series are developed.

The forecasts based on historical data are labeled "naive" forecasts because they are purely objective once the forecast methodology has been selected, and require no further informed judgement to produce. In that section, the cross-sectional distributional properties of the naive, historically based forecasts are presented and analyzed for agreement among methods. The historically based forecasts are then decomposed and analyzed along industry lines. In Sections 4.3, 4.4, and 4.5 the distributional properties of the IBES based forecasts are presented and those forecasts are compared with the historically based growth estimates at an aggregated sample level as well as within industrial classification. In Section 4.6, the Value Line forecast data is examined.

4.2 Long-term Growth Forecasts Derived From Historical Accounting Data

An almost infinite variety of alternative methods are available to extrapolate and forecast a measure of expected future growth from past observed growth. Methods commonly employed in public utility rate of return estimation vary from simple first differences and first ratios to sophisticated models incorporating moving averages and autoregressive tendencies. And while each method has its advocates, no single method of trending historical data is clearly superior to other methods at all points in time. In the following, fourteen different growth estimates are developed, each representing a

different computational method or different data period. These forecasts will be utilized as competitor measures in assessing the relative forecast accuracy of naive forecasts versus security analysts' forecasts.

The discrete-time-period, constant growth discounted cash flow model that is solved in terms of the cost of equity, k, is given by,

$$k = (D_1 / P_0) + g ,$$

where P_0 is the current stock price, D_1 is the dividend per share expected to be paid in the next time period, and g is the constant rate of periodic growth. Williams (1938/1956) and Gordon (1962) are credited with codifying the underlying assumptions of the discounted cash flow model, especially as regards the quantity whose growth rate is being capitalized by investors. In theory, the term g, represents the expected constant rate of growth in dividends paid to shareholders. As Williams pointed out, it is the cash flows (cash dividends) paid out or expected to be paid out that form the basis of value for both current and future investors. However, from the mathematical properties of the constant growth model, additional implications arise that cause the expected rate of growth of dividends to be equal to the expected rate of growth in earnings and the expected rate of growth of both book and market value. That is, all of these quantities are expected to grow at the same constant rate. The

equality of these anticipated growth rates in the theoretical model has provided a rational for examining more than just the rate of growth in historical dividends in making a forecast of the future growth rate to be used as an input to the model. In addition to dividends, cost of capital estimates have been made based on observed growth in earnings and growth in book value.

Further, in competitive equilibrium, where the stock price equals book value, the constant growth discounted cash flow model indicates that the growth term, g, is equal to the product of the earnings retention ratio, b, times the expected earned rate of return, E(ROE). This is the "plowback" of retained earnings into the productive endeavors of the business enterprise, which in turn gives rise to expected future growth in book value, earnings, and dividends. The concept of plowback also creates a rational for estimating expected future growth as a function of the observed historical earnings retention policy of the firm. Often the plowback approach uses a recent actual value of return on equity, ROE, as a proxy for E(ROE), and the the average historical retention ratio as a proxy for the expected retention ratio.

It would be impossible to test each and every type of historically based growth forecast methodology, there are simply too many different varieties. Instead, the methods employed here are representative of the range of possible methods and are the methods that have been most commonly observed in practice. They are as follows:

Table 4.1
Forecasts by Historical Methods

Type of Forecast (Name)	Mathematical Form	Data and Period	Restrictions
10 Year Point to Point DPS Growth (HD1)	$\left[\frac{DPS_{81}}{DPS_{71}}\right]^{1/10} - 1$	Annual DPS Adjusted for Splits 71 & 81	DPS must be positive in 1971 and 1981
5 Year Point to Point DPS Growth (HD2)	$\left[\frac{DPS_{81}}{DPS_{76}}\right]^{1/5} - 1$	Annual DPS Adjusted for Splits 76 & 81	DPS must be positive in 1976 and 1981
Most Recent Annual Growth In DPS (HD3)	$\left[\frac{DPS81}{DPS80}\right] - 1$	Annual DPS Adjusted for Splits 80 & 81	DPS must be positive in 1980 and 1981
Trended Growth In DPS 1971 to 1981 (HD4)	Estimated from Regression of Ln(DPS)=a+b*YR	Annual DPS Adjusted for Splits 71-81	Must have minimum of 8 positive values
10 Year Point to Point EPS Growth (HE1)	$\left[\frac{EPS_{81}}{EPS_{71}}\right]^{1/10} - 1$	Annual EPS Adjusted for Splits 71 & 81	EPS must be positive in 1971 and 1981
5 Year Point to Point EPS Growth (HE2)	$\left[\frac{EPS_{81}}{EPS_{76}}\right]^{1/5} - 1$	Annual EPS Adjusted for Splits 76 & 81	EPS must be positive in 1976 and 1981
Most Recent Annual Growth In EPS (HE3)	$\left[\frac{EPS81}{EPS80}\right] - 1$	Annual EPS Adjusted for Splits 80 & 81	EPS must be positive in 1980 and 1981
Trended Growth In EPS 1971 to 1981 (HE4)	Estimated from Regression of Ln(EPS)=a+b*YR	Annual EPS Adjusted for Splits 71-81	Must have minimum of 8 positive values
10 Year Point to Point BVS Growth (HB1)	$\left[\frac{BVS_{81}}{BVS_{71}}\right]^{1/10} - 1$	Annual BVS Adjusted for Splits 71 & 81	BVS must be positive in 1971 and 1981
5 Year Point to Point BVS Growth (HB2)	$\left[\frac{BVS_{81}}{BVS_{76}}\right]^{1/5} - 1$	Annual BVS Adjusted for Splits 76 & 81	BVS must be positive in 1976 and 1981

Table 4.1 --Continued

Type of Forecast (Name)	Mathematical Form	Data and Period	Restrictions
Most Recent Annual Growth In BVS (HB3)	$\left[\frac{BVS_{81}}{BVS_{80}}\right] -1$	Annual BVS Adjusted for Splits 80 & 81	BVS must be positive in 1980 and 1981
Trended Growth In BVS 1971 to 1981 (HB4)	Estimated from Regression of $Ln(BVS)=a+b*YR$	Annual BVS Adjusted for Splits 71-81	Must have minimum of 8 positive values
Weighted Average Plowback (H1)	$.5x(b_{81}xROE_{81})$ $+.3x(b_{80}xROE_{80})$ $+.2x(b_{79}xROE_{79})$	Actual Results For 1979-1981	Earnings and Retention must be positive
Most Recent Plowback (H2)	b_{81} x ROE_{81}	Actual Results For 1981	Earnings and Retention must be positive

Table 4.2 shown below gives the average value for each type of historical prediction, the standard deviation about the average value, and the number of usable predictions that met the computational restrictions shown above. The wide range of average forecast values hints at the significant disagreement among the forecasts by historical methods.

This is as anticipated since the objective of selecting the different methods was to give representation to exemplars of the various available methods without being overly repetitive. To confirm the distinctness of the historically based forecast, Pearson correlation coefficients are presented below in Table 4.3. The correlation coefficients are shown below the diagonal and the number of shared common observations are presented

Table 4.2
Descriptive Statistics
Growth Forecasts by Historical Methods

Forecast Method	Average Value	Standard Deviation	Number of Observations*
HD1	9.52%	8.74%	915
HD2	11.12	10.58	1032
HD3	9.75	12.47	1028
HD4	12.10	9.15	940
HE1	10.62	10.38	1106
HE2	8.63	13.57	1093
HE3	6.10	20.71	945
HE4	12.46	9.98	1118
HB1	3.07	6.32	1209
HB2	1.79	8.53	1207
HB3	3.69	17.56	1171
HB4	4.20	6.42	1156
H1	7.25	4.94	1062
H2	7.07	6.41	1122

*This sample has already been reduced to the largest common intersection with companies having usable IBES forecasts.On average, requiring a matching IBES forecast reduced the raw sample by about 800 observations. A comparative analysis of the distributions indicates that the dropped companies are no different, on average, than the survivors in the matched sample.

above the diagonal.[2] The average correlation is .24, with a high of .90 and a low of -.18. The lowest commonality of sample populations is still 82.75 percent (HD3 with HD2), thus statistical comparisons among the forecasts by historical methods have reasonable interpretations without being overly concerned with missing observations.

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[2]Note that the number of shared observations among the forecasts by historical methods differs depending upon the particular comparison. This is because the sample members were retained based on the maximum possible number of common observations between the forecasts by historical methods and the IBES data.

An additional set of statistics that allow testing of the hypothesis that all forecasts were equivalent has also been calculated. These tests require that all forecast methods share a common sample of observations and therefore are somewhat more restrictive than the simple correlations shown in Table 4.3. The first of these statistics is the Friedman test. The Friedman statistic tests for equivalence in the rankings of different forecast methods. That is, for a single firm, the forecasts of the k different methods are rank ordered from lowest to highest (from one to fourteen). Next across all b firms the rankings are summed by method. The average of the sum of the squared method rankings, normalized to the grand sum of the squared individual rankings, and adjusted for the appropriate degrees of freedom follows (approximately) an F-distribution.[3] Algebraically, the computation of the Friedman statistic is as follows:

$$T_2 = \frac{(b-1)[B_2-bk(k+1)^2/4]}{A_2 - B_2},$$

where $A_2 = \sum[R(X_{ij})]^2$, for $i = 1$ to b and $j = 1$ to k and, $B_2 = 1/b \sum R_j^2$, where $R_j = \sum R_{ij}$.

The null hypothesis, that all forecast methods are the same, is rejected at level a , if the value of T_2

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[3]Earlier forms of the Friedman statistic were designed to compare the computed value with the chi-square distribution. Iman and Davenport (1979) show that the F-approximation is clearly superior to the chi-square approximation.

exceeds the (1-a) quantile of the F-distribution with degrees of freedom (k-1) and (k-1)(b-1). If the null hypothesis is rejected, it is also possible to compare pairs of individual forecast methods to each other through the Friedman statistic relationship. This is simply the least significant difference test computed for ranks instead of the underlying data. This statistic will be referred to as the individual pairwise comparison. Forecast methods i and j are considered different if the following inequality is satisfied.

$$|R_j - R_i| > t_{1-a/2}\left(\frac{2b(A_2 - B_2)}{(b - 1)(k - 1)}\right)^{1/2}.$$

Inference about the level of agreement among the forecast methods can also be obtained by examining Kendall's coefficient of concordance (Kendall and Babington-Smith [1939]). Kendall's coefficient takes values from zero, for "perfect disagreement" among the forecasts to unity, for "perfect agreement." Algebraically, Kendall's coefficient of concordance is given as

$$W = \frac{(k-1)[bB_2-b^2k(k+1)^2/4]}{\dfrac{A_2-bk(k+1)^2/4}{b(k-1)}},$$

where A_2, B_2, b, and k are the same as defined above.

The computed Friedman value across all forecasts and the related Kendall coefficient of concordance are shown in Table 4.4. The critical F-value at a=.05 with degrees

of freedom 13 and 8814 is 2.21 and at a=.01 is 3.17. Thus, with a computed Friedman statistic of 194.763, the null hypothesis of equivalent forecasts can be rejected well beyond conventional confidence levels. This is confirmed by the low Kendall coefficient of 0.223. Also shown in Table 4.4 are the pairwise comparisons of forecast agreement based on the Friedman test. As shown in the table, the critical t-value for a=(.05/2) with 8814 degrees of freedom is about 1.96. From the algebraic relationship shown above, it follows that any computed value greater than 1.96 indicates that the null hypothesis of pairwise forecast equivalence can be rejected at the .975 level of significance. Statistically significant disagreement between the historical forecast methods occurred in 80 of the 91 unique pairwise comparisons.

In general, all of the statistics strongly indicate that the forecasts of the various methods are different. The low correlations and lack of agreement among the methods conforms to the testing methodology of this research. However, the lack of agreement also points out one of the more apparent weaknesses of using historically based forecasts. That is, with no clear right or wrong way to make forecasts based solely on accounting time series data, the results produced by selecting one method over another may differ significantly. That is, contrary to those who claim complete objectivity for historically based methods, the subjective choice of method or data series drives the results.

4.3 Comparison of Forecasts by Historical Methods Within Industry Classifications

Several studies have indicated that agreement among historically based forecasts is greater for certain industries than for others. For example Cragg and Malkiel (1983) found that the correlations among cyclical industries were lower on average than the correlations of the forecasts for the electric utility industry. Such a finding would be of particular interest to this study in that the thesis of poor consistency of historically based forecasts might be less defensible for the regulated utility companies. To investigate the possibility that historically based forecast methods were systematically different in terms of forecast agreement among the industry groups, the gross findings in Section 4.2 were further decomposed along industry lines.[4] Table 4.5 reports the mean and standard deviation of historically based forecast methods by industry group. Table 4.6 shows the Friedman and Kendall statistics by industry group across all historically based forecast methods. The tables in Appendices 3 and 4 report the simple correlation coefficients and the computed values of the statistic for pairwise comparisons within the industry classifications.

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[4]Appendix 2 provides a table of Standard Industrial Classification (SIC) codes assigned to each industry group.

Table 4.3
Agreement Among Growth Forecasts by Historical Methods
Pearson Correlation Coefficients and Number of Common Observations

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	----	895	877	872	881	869	782	889	915	914	904	895	820	859
HD2	.57	----	988	931	981	969	855	1003	1032	1032	1016	1009	914	956
HD3	.32	.49	----	904	985	977	865	999	1028	1028	1012	1007	920	959
HD4	.91	.68	.33	----	901	889	798	936	940	940	930	940	833	877
HE1	.65	.45	.41	.57	----	1056	914	1044	1106	1104	1074	1060	1013	1061
HE2	.25	.38	.45	.23	.62	----	913	1034	1093	1092	1061	1053	1003	1052
HE3	.37	.10	.23	.57	.25	.36	----	901	945	944	924	916	908	932
HE4	.49	.63	.44	.65	.80	.53	.14	----	1118	1118	1093	1118	990	1040
HB1	.18	.05	-.09	.08	.22	.03	-.02	.07	----	1207	1171	1156	1062	1122
HB2	-.03	-.02	-.12	-.04	-.01	.01	-.06	-.03	.64	----	1169	1155	1060	1120
HB3	-.02	-.04	-.05	-.04	-.07	-.03	-.02	-.05	.23	.39	----	1128	1030	1088
HB4	.03	.09	-.04	.09	.06	-.06	.00	.14	.82	.59	.13	----	1016	1074
H1	.28	.28	.30	.34	.39	.37	-.01	.49	-.16	-.17	.06	-.03	----	1061
H2	.25	.25	.36	.30	.49	.50	.22	.45	-.10	-.18	-.03	-.02	.89	----

Table 4.4
Agreement Among Growth Forecasts by Historical Methods

Friedman Statistic 194.763
Kendall Coefficient of Concordance 0.223

Pairwise Comparisions of Forecast Agreement

	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	1.29	0.48	6.64	1.12	4.95	6.27	7.39	20.76	21.35	13.89	16.99	13.37	13.70
HD2	0.00	0.81	5.35	0.16	6.24	7.57	6.10	22.06	22.65	15.19	18.29	14.67	15.00
HD3		0.00	6.16	0.64	5.43	6.75	6.91	21.24	21.83	14.37	17.47	13.86	14.19
HD4			0.00	5.52	11.59	12.92	0.75	27.41	28.00	20.54	23.64	20.02	20.35
HE1				0.00	6.07	7.40	6.27	21.89	22.48	15.02	18.12	14.50	14.83
HE2					0.00	1.32	12.34	15.81	16.40	8.94	12.04	8.42	8.75
HE3						0.00	13.67	14.48	15.08	7.61	10.71	7.10	7.43
HE4							0.00	28.16	28.75	21.29	24.39	20.77	21.10
HB1								0.00	0.59	6.86	3.76	7.38	7.05
HB2									0.00	7.46	4.36	7.98	7.64
HB3										0.00	3.10	0.51	0.18
HB4											0.00	3.61	3.28
H1												0.00	0.33
H2													0.00

Critical Value at a=.05, two tailed test, DOF=8814 is 1.96

Table 4.5
Summary Statistics for Growth Forecasts by Historical Methods
By Industry Group

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
AGRICULTURE & MINING														
Mean	16.4	14.8	13.1	16.7	20.5	18.1	-1.2	17.3	0.8	-3.2	-6.1	1.2	12.6	13.7
Standard Deviation	9.7	13.7	20.1	9.2	12.5	17.1	27.6	15.4	15.4	12.0	20.4	6.7	4.8	8.5
BANKING														
Mean	5.9	7.9	9.4	5.8	8.3	11.0	5.6	9.2	3.0	3.0	0.7	3.7	5.8	6.1
Standard Deviation	4.1	6.4	9.6	6.2	3.7	6.8	13.4	4.4	3.2	5.3	17.2	3.6	2.9	3.4
CHEMICALS & DRUGS														
Mean	11.5	10.6	10.9	12.6	10.4	7.9	5.0	11.4	4.4	3.5	0.4	5.5	7.0	7.2
Standard Deviation	7.7	8.1	11.3	8.4	7.2	11.6	17.1	6.9	5.0	6.8	16.9	5.5	3.5	4.3
COMMUNICATIONS														
Mean	8.5	13.9	12.3	10.2	13.6	8.0	0.6	14.9	5.4	3.5	5.2	6.5	5.8	5.7
Standard Deviation	6.7	13.3	16.2	7.6	10.9	17.6	21.9	11.1	4.6	4.8	21.5	6.3	3.4	3.2
CONSTRUCTION														
Mean	9.6	11.8	11.8	17.1	14.8	5.7	5.9	17.8	5.7	3.5	9.8	3.9	10.1	9.3
Standard Deviation	7.6	9.7	8.5	13.2	13.0	13.2	19.8	11.8	8.1	10.3	6.8	9.6	2.6	3.6
CONSUMER GOODS														
Mean	13.5	14.1	10.9	16.7	10.9	4.5	5.7	12.7	4.6	3.7	-0.4	6.1	7.4	7.0
Standard Deviation	5.4	7.7	8.7	7.2	9.4	15.2	24.3	8.9	5.9	7.4	17.6	7.6	3.8	4.3
ELECTRONICS														
Mean	10.6	12.5	8.7	12.9	14.7	11.1	8.7	16.2	4.8	3.4	0.4	6.1	7.8	7.9
Standard Deviation	9.3	12.3	12.2	10.5	10.9	13.8	22.9	10.7	6.9	8.9	18.6	7.9	4.7	6.3
FOOD & BEVERAGE														
Mean	9.5	10.2	12.7	11.7	12.6	10.9	12.4	13.5	2.5	2.7	1.0	3.2	5.6	6.0
Standard Deviation	5.4	6.1	10.4	6.0	6.7	9.7	13.4	6.4	5.4	7.6	19.3	5.6	2.9	3.6
FOREST PRODUCTS														
Mean	12.1	12.2	9.9	13.6	10.2	4.3	-3.2	10.8	4.3	4.0	2.7	4.7	6.4	5.5
Standard Deviation	6.5	7.5	11.1	9.2	9.4	11.9	20.2	6.7	4.1	6.3	14.2	5.2	2.9	3.4
MACHINERY														
Mean	10.2	12.5	10.3	13.6	13.6	11.4	4.0	14.7	2.1	-0.1	-2.2	2.7	8.9	9.7
Standard Deviation	8.5	12.2	18.6	10.7	11.9	14.9	25.4	11.5	6.9	9.3	18.2	7.5	4.2	6.3

Table 4.5--continued

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
METALS														
Mean	12.1	11.1	7.6	12.1	11.2	7.2	1.7	10.4	3.1	0.6	0.1	2.9	8.7	8.1
Standard Deviation	8.3	8.1	12.1	10.3	9.8	14.7	23.5	9.8	4.2	6.9	18.7	4.7	5.8	7.7
NON-BANK FINANCE														
Mean	12.6	14.0	7.5	15.6	9.8	8.1	4.7	13.5	3.5	3.8	1.6	5.4	6.3	4.7
Standard Deviation	8.9	9.6	12.5	7.6	6.9	9.8	16.3	7.9	5.4	6.6	15.1	5.5	3.3	7.4
OFFICE EQUIPMENT														
Mean	17.2	13.3	15.3	19.9	14.8	8.5	-4.5	19.0	1.7	-0.2	0.8	3.6	6.9	6.5
Standard Deviation	6.9	7.2	9.3	5.9	4.6	1.2	29.1	8.9	4.3	9.8	14.9	4.5	3.1	3.6
PETROLEUM REFINING														
Mean	13.4	13.2	13.2	13.7	17.9	14.9	-7.1	16.5	2.3	-0.2	0.3	2.8	11.0	9.9
Standard Deviation	5.3	12.7	12.9	5.9	10.2	15.0	21.9	10.5	8.1	10.5	20.5	8.9	5.1	5.0
PUBLISHING & PRINTING														
Mean	13.9	13.2	9.9	15.3	13.8	12.9	11.6	15.5	6.5	3.1	-3.8	7.7	6.5	7.2
Standard Deviation	7.7	7.0	11.3	7.7	5.1	7.9	9.9	6.2	6.9	7.1	2.4	7.7	4.6	5.5
REAL ESTATE														
Mean	10.3	20.9	12.7	10.1	4.4	13.9	1.3	12.3	2.0	3.3	-2.2	2.6	7.4	6.4
Standard Deviation	11.9	13.2	14.6	11.6	13.9	18.5	24.6	13.4	4.2	7.5	14.5	5.2	10.6	8.8
RESTAURANTS & SPECIALTY TRADE														
Mean	14.9	14.1	8.4	17.6	12.6	9.7	18.6	14.9	7.7	8.3	7.1	7.5	5.2	5.8
Standard Deviation	10.6	13.3	12.4	12.0	8.3	11.4	12.8	7.9	5.0	8.7	15.9	5.5	2.1	2.8
RETAIL TRADE														
Mean	12.5	12.0	10.5	15.6	11.5	7.8	8.8	12.9	4.5	2.3	2.7	5.3	5.8	5.4
Standard Deviation	9.3	10.0	10.9	8.7	8.0	11.5	16.8	9.9	6.5	8.9	15.9	5.4	5.4	4.5
RUBBER, PLASTIC & LEATHER PRODUCTS														
Mean	8.1	10.6	8.2	11.3	9.7	7.6	11.5	11.1	5.1	2.0	0.3	6.0	6.9	7.2
Standard Deviation	8.4	10.3	15.1	10.9	10.4	15.3	25.3	9.5	4.2	7.4	18.1	4.4	4.0	5.3

Table 4.5--continued

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
SERVICE														
Mean	15.6	17.5	11.8	19.0	13.4	10.5	6.3	16.9	6.0	5.0	2.8	7.2	9.1	7.6
Standard Deviation	7.2	11.3	13.9	9.1	11.4	15.8	21.3	9.1	7.4	6.9	18.8	6.6	6.1	6.1
SOCIAL SERVICES														
Mean	21.2	24.2	18.3	28.2	23.3	19.3	18.8	19.3	2.9	-1.5	-5.6	3.3	7.5	8.9
Standard Deviation	12.1	12.7	11.4	13.8	10.8	12.3	20.1	17.5	5.4	10.4	24.9	6.7	3.4	4.8
STONE, CLAY, GLASS & CONCRETE PRODUCTS														
Mean	7.9	8.9	5.7	10.5	10.5	5.9	-8.5	12.9	4.1	2.8	4.5	4.5	7.4	7.1
Standard Deviation	2.3	4.2	10.7	5.9	10.3	15.1	17.6	7.3	6.3	5.4	11.3	8.4	4.4	5.5
TEXTILES														
Mean	7.0	6.5	7.4	8.9	8.9	9.6	15.7	7.8	3.8	4.6	2.9	4.3	5.9	6.8
Standard Deviation	6.7	11.6	15.5	8.3	5.7	12.1	28.8	8.7	5.9	6.5	16.9	8.3	3.6	4.9
TRANSPORTATION														
Mean	9.2	10.1	14.9	11.6	10.8	7.2	-0.1	11.1	3.2	-0.0	1.0	5.0	7.4	6.1
Standard Deviation	7.9	11.0	18.1	8.3	6.6	16.2	19.6	10.1	8.6	8.3	21.5	8.2	7.3	11.1
TRANSPORTATION EQUIPMENT														
Mean	9.8	7.1	5.0	12.7	10.8	3.6	-2.8	14.3	2.2	0.1	-0.6	2.9	8.8	6.3
Standard Deviation	10.6	15.2	15.2	9.1	12.4	18.4	25.8	11.1	6.1	9.3	16.0	6.2	5.7	12.9
UTILITES														
Mean	5.0	5.7	6.7	5.6	4.2	4.8	10.0	4.6	1.5	0.7	1.2	1.7	4.0	4.2
Standard Deviation	3.6	4.2	5.6	4.0	4.9	6.9	16.8	4.8	2.9	4.4	8.4	3.3	2.6	2.9
WHOLESALE TRADE														
Mean	11.9	11.1	11.6	14.8	10.7	8.1	5.7	13.8	3.9	2.6	-6.1	4.8	7.0	6.3
Standard Deviation	7.5	9.5	12.6	8.6	8.8	14.4	21.2	7.8	5.2	7.7	20.7	6.3	3.6	4.4

Table 4.6
Forecasts by Historical Methods
Forecast Agreement within Industrial Classifications

Industry	Friedman Statistic	F-Value (a=.05)	Kendall Coefficient
Agriculture and Mining	6.5044	1.78	0.3334
Banking	15.6797	1.78	0.2250
Chemicals and Drugs	12.1092	1.78	0.1777
Communications	1.2092*	2.01	0.3768
Construction	1.8056*	1.96	0.4461
Consumer Goods	9.8498	1.78	0.3414
Electronics	14.8655	1.78	0.2614
Food and Beverage	23.4681	1.78	0.3946
Forest Products	7.0170	1.78	0.2597
Machinery	11.9998	1.78	0.2857
Metals	11.9511	1.78	0.2918
Non-Bank Finance	22.5828	1.78	0.4062
Office Equipment	5.4164*	1.94	0.5752
Petroleum Refining	10.7942	1.78	0.3748
Publishing and Printing	13.1820	1.78	0.3856
Real Estate	3.9022*	1.92	0.4383
Restaurants and Specialty Trade	6.5213*	1.75	0.4490
Retail Trade	14.3723	1.78	0.3313
Rubber, Plastic and Leather Products	1.7941	1.78	0.1402
Service	7.6270	1.78	0.2760
Social Services	12.1119*	1.92	0.7517
Stone, Clay, Glass and Concrete Products	6.5017	1.78	0.3714
Textiles	1.8240	1.78	0.1319
Transportation	4.4421	1.78	0.2546
Transportation Equipment	10.5176	1.78	0.3688
Utilities	50.0032	1.78	0.2873
Wholesale Trade	6.7476	1.78	0.2620

Note: The validity of assuming that the F-distribution is accurate as an approximation to the the distribution of the computed Friedman statistic is less certain when the number of firms within an industry group is small. See, for example, Conover (1980), page 300. Industry classifications containing less than 20 firms are denoted by an asterisk.

Inspection of Table 4.5 indicates that there are industry specific effects regarding the level and dispersion of forecasts. However, the forecast methods within industries appear to exhibit about the same level of disagreement as was shown for the entire population. As shown in Table 4.6, the null hypothesis of equivalent forecasts across all methods was rejected at the .95 level for all industrial classifications except Communications and Construction. These two groups, however, contained only 9 and 11 companies, respectively. These small samples tend to lessen the validity of the assumptions underlying the the Friedman test.

As shown in Table 4.6, for the Utilities group, the null hypothesis of forecast agreement among all historically based forecast methods is rejected well beyond conventional significance levels. However, the individual pairwise comparisons of forecast agreement based on the Friedman test for the Utilities as shown on Page 13 of Appendix 4, do indicate some limited evidence of agreement between forecast methods based on dividends per share and earnings per share. For these methods, the null hypothesis of forecast agreement could not be rejected at the .95 level for 10 of 28 comparisons. Of interest is the total lack of correlation and agreement of the book value per share based forecast methods. As shown in Appendix 3, correlation coefficients for the book value

per share based methods were either close to zero or negative with all other methods.

4.4 Comparison of Historically Based Forecasts With Forecasts Made by Security Analysts

This section of the analysis is primarily concerned with the examination of the correlations and level of agreement among the historically based methods and the IBES based forecasts. A high level of correlation between the IBES forecasts and a particular historically based method might indicate that that method was serving as a basis for the security analysts' forecasts. Lack of correlation tends to suggest that the security analysts are incorporating more information than just the trends observed from past periods in making their forecasts.

From Section 4.3 recall that the summary statistic database of IBES provides the lowest and highest forecast made by analysts on a particular company (LOIBES and HIIBES), the mean forecast across all analysts for that company (MNIBES), and the median forecast (MDIBES). Descriptive statistics for these data variables for the five year growth forecasts made in January 1982 across the total sample population are shown below in Table 4.7.

The total sample was screened further to eliminate firms where less than three analysts made forecasts. The primary reason was to mitigate the influence of an

Table 4.7
Descriptive Statistics
IBES Forecasts (Full Sample)

IBES Variable	Average Value	Standard Deviation	Number of Observations
LOIBES	12.819%	8.313%	1813
HIIBES	21.277	32.494	1813
MNIBES	16.334	12.830	1813
MDIBES	15.679	10.404	1813

individual brokerage firm or security analyst on the final results. That is, to the extent possible it is desired that the IBES forecast represent a consensus as opposed to an individual forecast. The resulting sample was is described in summary as follows in Table 4.8.

Table 4.8
Descriptive Statistics
IBES Forecasts (Reduced Sample)

IBES Variable	Average Value	Standard Deviation	Number of Observations
LOIBES	11.933%	7.480%	1209
HIIBES	21.815	38.944	1209
MNIBES	15.061	10.913	1209
MDIBES	15.920	14.247	1209

Table 4.9 presents the Pearson correlation coefficients between the historically based method forecasts and the IBES forecasts.As shown, at a total sample level only the low forecast (LOIBES) and the median forecast (MDIBES) display any consistent positive correlation with the historically based forecasts. However, even this correlation is low, with a maximum value of only .3436 of MDIBES with HE4. Although somewhat limited in interpretation, this result is indicative of similar correlations reported by Cragg and Malkiel (1983).

They computed correlations between a historically based forecast identical to HE4 measured over the years 1954 to 1963, and the seven security analysts' forecasts of long-term growth they had obtained for 1963. They found positive and statistically significant correlation coefficients between this historically based measure and six of the seven analysts forecasts. They concluded their results suggested that the individual security analysts were utilizing the historical results as a basis for their own forecasts. However, it should be recalled from Chapter 3, that the Cragg and Malkiel sample of companies was dominated by large, successful mature

Table 4.9
Agreement Among Forecasts by Historical Methods and IBES Forecasts
Pearson Correlation Coefficients
Number of Common Observations Shown in Parenthesis

	LOIBES	HIIBES	MNIBES	MDIBES
HD1 (915)	.1027	-.0468	.0204	.1652
HD2 (1032)	.1991	-.0873	.0439	.2461
HD3 (1028)	.2416	-.0175	.1596	.2325
HD4 (940)	.2453	-.0103	.0973	.3083
HE1 (1106)	.1624	.0676	.1782	.2185
HE2 (1093)	.1376	-.0607	.0710	.1341
HE3 (945)	.1698	-.0356	.0506	.1314
HE4 (1118)	.3112	.0163	.1623	.3436
HB1 (1209)	-.0550	-.0194	-.0464	-.0675
HB2 (1207)	-.0813	-.0509	-.0833	-.1029
HB3 (1171)	-.0029	-.0439	-.0355	-.0327
HB4 (1156)	.1043	.0095	.0322	.0381
H1 (1062)	.2413	.1387	.2469	.2848
H2 (1122)	.2832	-.1199	-.0101	.0367

Correlation coefficients greater than .06 and less than -.06 are significantly different than zero at approximately a .95 level.

firms. The sample results that are reported here are derived from a much more diverse set of companies. The

correlations shown in Table 4.9 do not unambiguously support the same conclusion as reached by Cragg and Malkiel.

At best, those correlations can not be used to rule out some use of historically based earnings growth trend information by security analysts. The low and negative correlations of the IBES data with book value per share based historical growth does suggest, however, that that data series is not particularly important in the formation of security analysts' forecasts.

Friedman and Kendall statistics and pairwise tests of of least significant differences were also computed in order to provide an additional reference in the comparison of IBES and historically based forecasts. Table 4.10 presents these computations. The computed Friedman statistic of 359.992 indicates strong rejection of the hypothesis of equivalence among the ranking of the forecast methods. This is confirmed by the low Kendall coefficient of .34. Comparisons among the individual pairs of forecasts indicate that equivalence of forecast rankings can be rejected for all but the pair, LOIBES with HD1.

4.5 Comparisons of Forecasts by Historical Methods and IBES Forecasts Within Industrial Classifications

Table 4.12 provides intraindustry computations of the Friedman and Kendall statistics. As with the

Table 4.10
Agreement Among Forecasts by Historical Methods and IBES Forecasts

Friedman Statistic	359.992
Kendall Coefficient of Concordance	.3468

Pairwise Comparisons of Forecast Agreement

	LOIBES	HIIBES	MNIBES	MDIBES
HD1	1.7746	31.6939	18.0736	17.0559
HD2	3.0319	30.4366	16.8163	15.7986
HD3	3.2632	30.2053	16.5850	15.5673
HD4	11.2865	22.1820	8.5616	7.5440
HE1	2.8511	30.6174	16.9971	15.9794
HE2	4.6593	38.1278	24.5074	23.4898
HE3	4.2724	37.7409	24.1205	23.1029
HE4	12.1023	21.3662	7.7458	6.7282
HB1	28.7378	62.2063	48.5859	47.5683
HB2	29.3181	62.7866	49.1662	48.1486
HB3	18.5109	51.9794	38.3591	37.3414
HB4	24.0280	57.4965	43.8762	42.8585
H1	19.3519	52.8204	39.2001	38.1824
H2	19.2931	52.7616	39.1412	38.1236

Critical Value at a=.05 is 1.96.

historical forecasts alone, the hypothesis of equal forecast ranking within industries is generally rejected. Rejection of the null hypothesis at the .95 level or higher was possible for all but the Construction industry. As noted in Section 4.3, the validity of the of the assumptions underlying the test is limited when sample sizes are small. The somewhat greater computed values of the Friedman statistic for this comparison versus the values for the forecasts by historical methods alone are primarily attributable to HIIBES which was always significantly different from all other methods.

Individual pairwise comparisons of the forecasts by historical methods with the IBES forecasts on an

intraindustry basis are found in Appendix 5. The most interesting observation about this data is the significant difference between forecasts by historical methods based on either book value per share or plowback data and the IBES forecasts. Figures 4.1 and 4.2 help to summarize the pairwise comparisons. In Figure 4.1, the percentage of tests in which the null hypothesis was rejected is shown by the height of the bar. The comparison is between the forecast by historical method identified on the horizontal axis and all IBES methods. The null hypothesis of equivalent forecast ranking was rejected, on average, in about 35 percent of the tests for method HE4, in about fifty percent of the tests for methods HD1, HD2, HD3, HD4, and HE1, and in about 70 percent of the tests for methods HE2 and HE3. In contrast, the null hypothesis was rejected in about 90 percent of the tests for all HB (book value per share) and H (plowback) methods. For the Utilities, the comparisons follow somewhat similar patterns, although methods HD2 and HD4 were found to consistently different. This examination tends to confirm the earlier assertion that security analysts are not generally using observed growth in book value as a basis for their own forecasts. Surprisingly, it appears that the plowback methods also have little influence on their forecasts. Security analysts do, however, appear to utilize the observed growth patterns in dividends and earnings per share in formulating their forecasts.

Table 4.11
IBES Forecasts
Intraindustry Summary Statistics

Industry	LOIBES		HIIBES		MNIBES		MDIBES	
	Average Value	Std. Dev.	Average Value	Std. Dev.	Average Value	Std. Dev.	Average Value	Std. Dev.
AGRICULTURE AND MINING	17.48%	9.68%	26.16%	14.63%	21.39%	10.21%	21.06%	10.35%
BANKING	10.50	6.28	14.91	6.92	12.23	5.86	12.04	5.85
CHEMICALS AND DRUGS	11.62	4.07	18.92	6.96	14.95	4.10	14.67	4.04
COMMUNICATIONS	12.36	4.53	20.93	7.96	16.32	5.89	16.40	6.57
CONSTRUCTION	11.00	3.43	18.36	9.85	13.67	4.72	13.06	4.41
CONSUMER GOODS	15.01	8.09	26.98	30.60	18.75	8.18	18.02	7.63
ELECTRONICS	15.51	9.46	23.39	11.52	19.17	9.76	18.89	9.80
FOOD AND BEVERAGE	11.93	6.42	15.40	6.88	13.62	6.36	13.58	6.37
FOREST PRODUCTS	10.95	7.49	23.66	11.59	16.18	6.24	15.26	6.01
MACHINERY	12.96	5.73	21.65	9.50	16.72	5.95	16.32	5.85
METALS	10.24	6.04	19.35	12.57	14.07	4.88	13.58	4.52
NON-BANK FINANCE	9.22	4.12	27.40	69.06	15.27	17.51	12.45	3.06
OFFICE EQUIPMENT	11.40	1.94	15.60	2.60	13.67	2.08	13.50	2.23
PETROLEUM REFINING	9.67	4.14	21.15	12.40	14.80	7.13	14.44	7.33
PUBLISHING AND PRINTING	13.43	4.78	18.77	5.34	15.89	4.03	15.94	4.22
REAL ESTATE	12.34	6.30	15.95	9.05	13.59	6.27	13.31	6.10
RESTAURANTS & SPEC. TRADE	13.84	4.40	18.23	4.87	15.91	3.98	15.72	4.22
RETAIL TRADE	12.13	7.50	17.21	7.80	14.58	7.00	14.42	6.95
RUBBER,PLASTIC & LEATHER	11.98	6.41	20.15	11.97	15.30	6.63	14.75	6.68
SERVICE	13.93	5.96	40.05	90.87	24.04	33.33	18.34	11.67
SOCIAL SERVICES	15.61	6.33	25.12	5.74	21.24	4.73	21.47	5.05
STONE,CLAY,GLASS & CONCRETE PRODUCT	10.47	11.40	26.43	20.39	15.94	10.86	14.58	10.45
TEXTILES	12.58	9.79	16.63	8.80	14.45	9.01	14.18	9.23
TRANSPORTATION	11.66	5.35	22.42	10.54	15.94	5.21	15.16	5.30
TRANSPORTATION EQUIPMENT	11.45	6.01	65.49	159.53	29.75	51.62	22.13	40.63
UTILITIES	4.97	3.31	8.86	5.46	6.72	3.96	6.57	3.94
WHOLESALE TRADE	13.31	5.45	18.65	12.11	15.56	5.24	14.99	4.78

Table 4.12
Forecasts by Historical Methods and IBES Forecasts
Forecast Agreement Within Industrial Classifications

Industry	Friedman Statistic	F-Value (a=.05)	Kendall Coefficient
Agriculture and Mining	7.4153	1.78	0.3632
Banking	38.3113	1.78	0.4150
Chemicals and Drugs	32.3113	1.78	0.3680
Communications	2.5140*	2.01	0.5569
Construction	0.9695*	1.96	0.4922
Consumer Goods	16.3473	1.78	0.4624
Electronics	29.4318	1.78	0.4120
Food and Beverage	30.0604	1.78	0.4550
Forest Products	12.4495	1.78	0.3836
Machinery	22.6625	1.78	0.4303
Metals	16.0741	1.78	0.3566
Non-Bank Finance	29.3833	1.78	0.4710
Office Equipment	7.0950*	1.94	0.6394
Petroleum Refining	13.7018	1.78	0.4322
Publishing and Printing	20.3252	1.78	0.4918
Real Estate	4.0072*	1.92	0.4448
Restaurants and Specialty Trade	8.2580*	1.75	0.5079
Retail Trade	20.7160	1.78	0.4166
Rubber, Plastic and Leather Products	4.9308	1.78	0.3095
Service	9.7943	1.78	0.3287
Social Services	10.0785*	1.92	0.7158
Stone, Clay, Glass and Concrete Products	12.6137	1.78	0.5341
Textiles	5.5802	1.78	0.3174
Transportation	8.9237	1.78	0.4070
Transportation Equipment	15.3821	1.78	0.4607
Utilities	76.9467	1.78	0.3829
Wholesale Trade	12.0168	1.78	0.3874

Note: The validity of assuming that the F-distribution is accurate as an approximation to the the distribution of the computed Friedman statistic is less certain when the number of firms within an industry group is small. See, for example, Conover (1980), page 300. Industry classifications containing less than 20 firms are denoted by an asterisk.

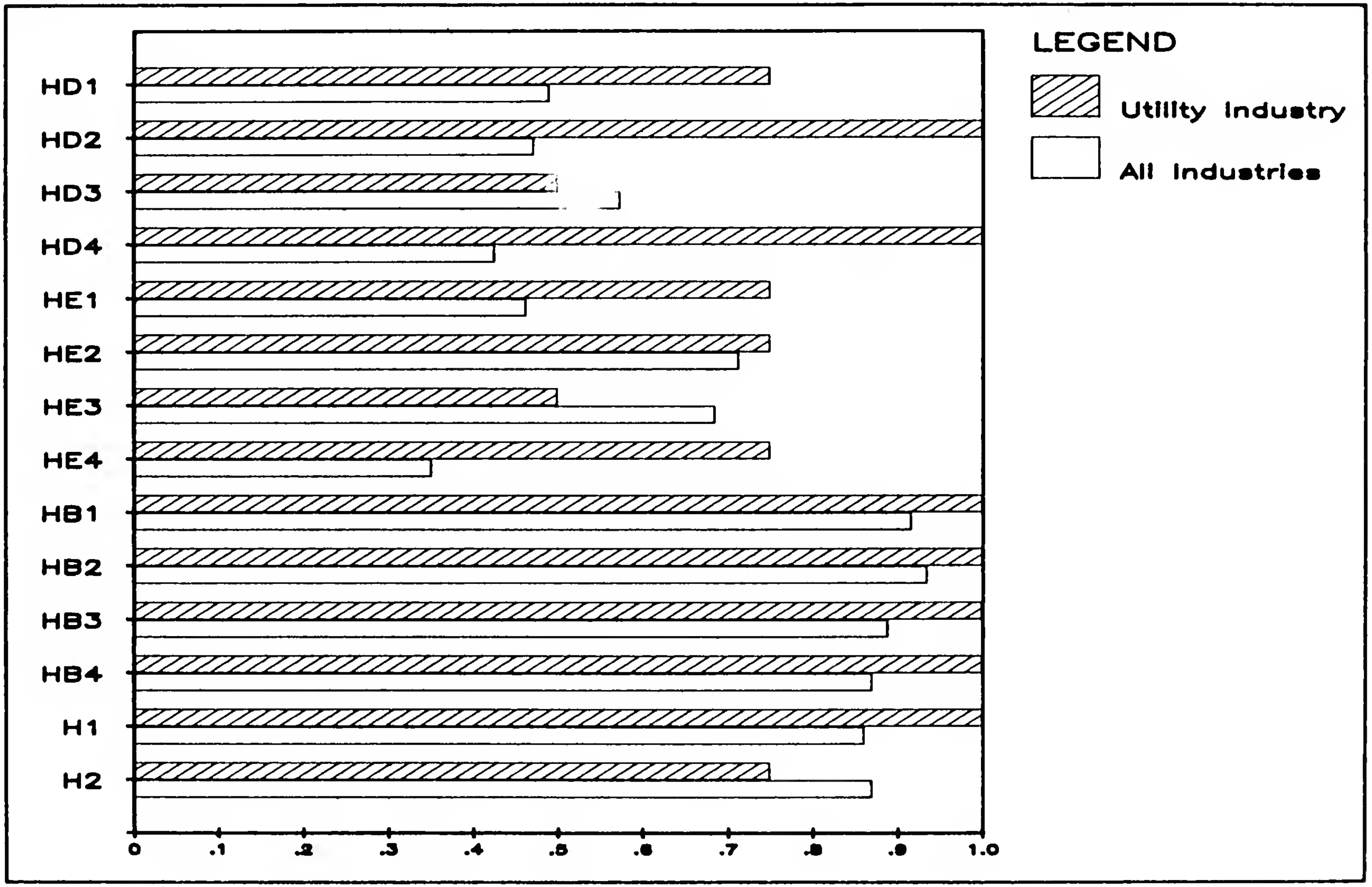

Figure 4.1
Comparision of Forecasts by Historical Methods to IBES Forecasts
Percentage of Tests Where Equivalence Was Rejected

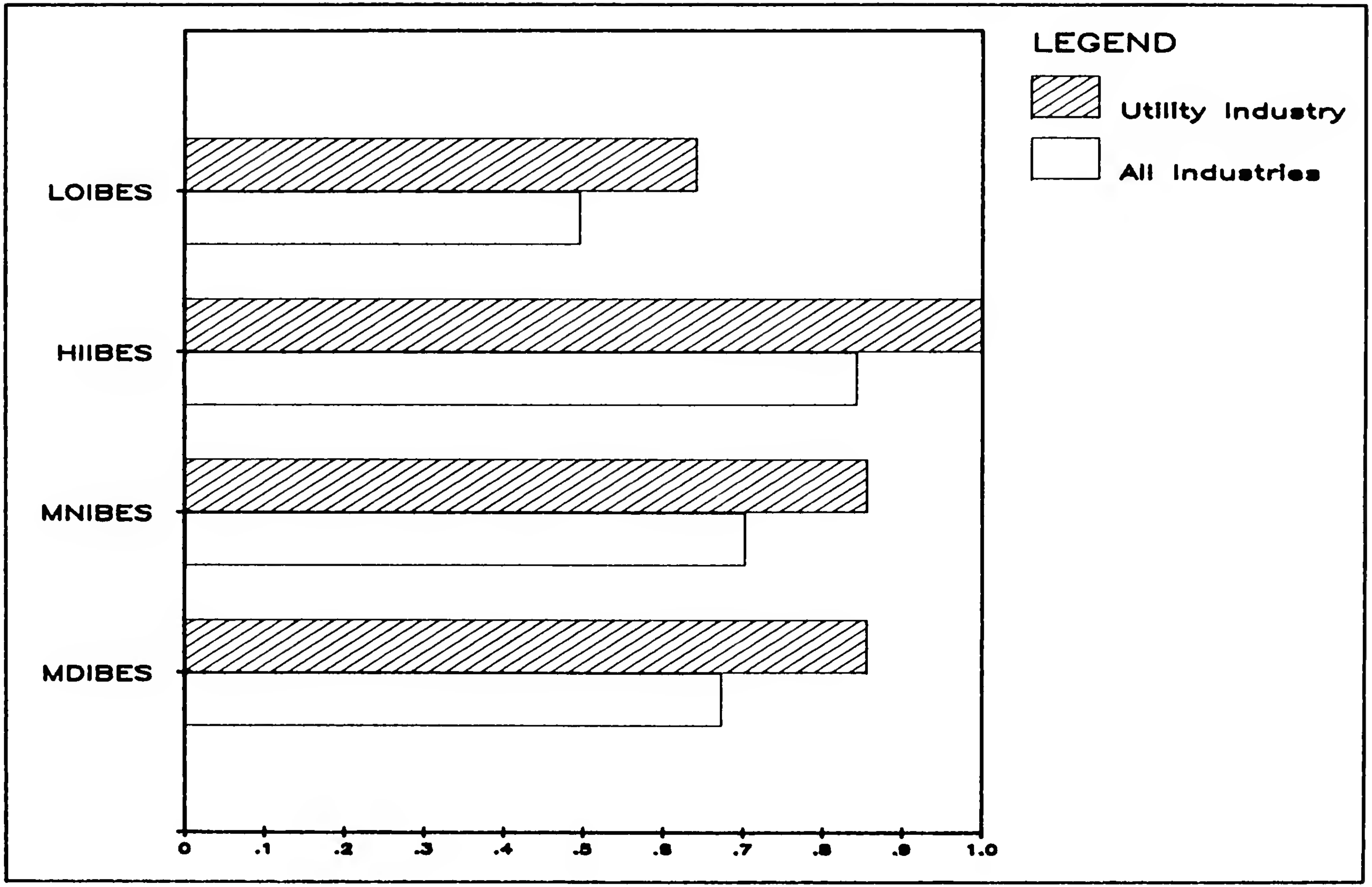

Figure 4.2
Comparision of IBES Forecasts to Forecasts by Historical Methods
Percentage of Tests Where Equivalence Was Rejected

Figure 4.2 shows the percentage of tests where the null hypothesis was rejected in comparisons of the individual IBES forecasts identified on the horizontal axis with all forecasts by historical methods. As with the coarser examination at the total sample level, only LOIBES indicated any agreement with the historically based methods. This result, however, can be interpreted as suggesting that the analysts providing the more conservative forecasts tend to rely more heavily on historically based data. The Utilities group exhibited a similar pattern of test rejection, although the rejection percentage was always higher than for the total set of companies.

4.6 Value Line Forecasts of Growth

As a subset of security analysts' forecasts, the Value Line Investor Service forecasts of dividend and earnings growth were separately utilized in this study. Value Line is ubiquitous, having the largest paid circulation of any investment advisory service as well as being freely available in many public libraries. Due to the general availability of Value Line, the data has often served as a basis for studies of the importance of security analysts' forecasts. For example, Brown and Roseff found that Value Line forecasts of short-term earnings per share were consistently superior to naive forecasts.

Brigham and Vinson (1982) found Value Line forecasts of earnings per share growth were generally equivalent in mean value to consensus forecasts of earnings per share growth determined from the individual analysts' forecasts contained in Standard and Poor's Earnings Forecaster. This finding was utilized to support the conclusion that the more generally available Value Line forecasts could serve as a reasonable proxy for the consensus forecasts in cost of capital studies. This study re-examines that earlier finding through comparison of the Value Line forecasts to a much broader measure of the consensus of security analysts' forecasts.

Value Line publishes a forecast of the dollar amount of earnings per share and dividends per share expected to occur in the next three to five years. Thus, the forecast quantity can be interpreted as a three-year-ahead forecast, a four-year-ahead forecast, or a five-year-ahead forecast. The IBES service includes the Value Line forecast as a five year forecast. If, as is appropriate to its use in the constant growth discounted cash flow model, the Value Line forecast is considered to be a parameter describing growth as opposed to an arithmetic value specifically connecting two points in time, then the three, four, or five year distinction is not critical. In this study, the forecasted dollar amount of earnings per share and dividends per share were transformed into percentage growth forecasts by taking the one-fourth root

of the first ratio of the respective forecast quantity to the respective 1981 actual value. The acronym VLGD is used for the computed Value Line forecast of dividend per share growth and VLGE represents the computed forecast of earnings per share growth.

The size of the Value Line sample was constrained by limited data availability to a group of firms composed of all regulated utility companies followed by Value Line at the beginning of 1982.

Descriptive statistics for the Value Line sample are presented below. In Table 4.14, the simple correlation coefficients between the Value Line forecasts and the forecasts by historical methods and IBES forecasts are shown. In general, the Value Line forecasts do not appear materially different from the IBES consensus measures, although the dispersion of Value Line forecasts is somewhat greater. The correlations of the Value Line forecasts with forecasts by historical methods are small and often negative. The correlations of the Value Line forecasts with the IBES forecasts are statistically significant and always positive but tend to be low in value for the total sample.

Table 4.13
Descriptive Statistics
Value Line Forecasts

Value Line Variable	Average	Standard Deviation	Number of Observation
VLGD	6.724%	7.052%	133
VLGE	7.609	8.853	134

TABLE 4.14
<u>Value Line</u> Forecasts
Agreement With Forecasts by Historical Methods and IBES Forecasts
Correlation Coefficients Within Utilities

	VLGD	VLGE
HD1	0.27866	0.09886
HD2	0.28405	0.11011
HD3	0.22755	0.07919
HD4	0.24357	0.03881
HE1	0.21841	-0.19350
HE2	0.22941	-0.19255
HE3	0.14607	-0.15894
HE4	0.21298	-0.21227
HB1	0.11474	0.04968
HB2	0.12695	0.12182
HB3	0.04955	-0.00540
HB4	0.18805	0.10795
H1	-0.14960	-0.32806
H2	-0.06287	-0.31376
LOIBES	0.29132	0.15131
HIIBES	0.22548	0.23708
MNIBES	0.28278	0.24129
MDIBES	0.26133	0.22938

CHAPTER FIVE

AN EXAMINATION OF FORECAST ACCURACY

5.1 Introduction

In this chapter forecasts by historical methods and security analysts' forecasts of long-term growth are examined to discern which, if any, of the forecast methods exhibit the desirable properties of estimators discussed in Chapter One. In Sections 5.2, 5.3, 5.4 and 5.5 actual growth rates are computed and the forecasts are compared to these actual growth values in order to determine relative forecast accuracy.[1] In addition to the eighteen primary growth forecasts, the accuracy of the two Value Line forecasts are evaluated for the the Utility group companies. Both absolute accuracy and relative, comparative accuracy of the methods are evaluated. The

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[1]As was explained in Chapter 3, a determination that a particular forecasting method dominates all others in terms of forecast accuracy is not sufficient to infer that that method is preferred by investors in the formulation of their expectations, unless it is assumed concurrently that investor behavior is fully explained by the rational expectations hypothesis. In that sense, this investigation of forecast accuracy is at best a beginning of a continuing examination of forecast accuracy through time. It will require numerous such analyses that create a time series of comparative studies to distinguish between the competing theories of the formation of investor expectations.

forecast errors are disaggregated and analyzed by industry classifications and for the utility companies, the forecast errors are further disaggregated and analyzed by utility sectors.

In Sections 5.6, 5.7 and 5.8, following Theil (1962), Crichfield, Dyckman, and Lakonishok (1978), and Elton, Gruber, and Gultekin (1981), the forecast errors are decomposed through statistical techniques that allow detection of systematic bias and inefficiency in the utilization of information, as well as other sources of error produced by the forecast method's inability to account for intraindustry effects on the relevant parameters. In addition to these analyses, the mean square forecast errors of the Utility group companies are further decomposed into their constituent sources of error by utility sector. In Section 5.9, the relationship between the forecasts and the cross-sectional structure of price earnings ratios is examined in an attempt to detect which forecasts are being used by investors in the formulation of their expectations. The empirical results and related statistical inference of this chapter serve as the basis for the study's overall conclusions about the comparative usefulness of competing methods of estimating growth that can be used in the constant growth discounted cash flow model.

5.2 Computation of Actual Growth Rates and Forecast Errors

The actual growth in earnings per share and dividends per share is measured over the five-year period January 1982 through December 1986. This measurement period coincides with the stated forecast horizon of the IBES consensus forecasts made in January 1982. Further, while the forecasts by historical methods can not be assigned to any specific forecast horizon, this five-year period appears to be long enough to provide a realistic basis of comparison between the IBES consensus forecasts and the forecasts by historical methods.

An immediate difficulty encountered in examining forecast accuracy is the establishment of exactly what is meant by actual growth outcomes. That is, there is not a natural, single method of computing actual growth and the existing literature has not established a universal convention of what is meant by actual growth. In this study, actual growth rates have been computed by a geometric averaging process that takes the appropriate root of first ratios of the relevant dollar quantities,

$$g_{actual} = \left(\frac{A_{t+n}}{A_t} \right)^{1/n} - 1 .$$

This method appears to be in keeping with the compounding, geometric growth that is implied by the constant growth rate discounted cash flow model. However, to obtain real number results this method requires that the first ratio

be positive, which in turn means that both the beginning and ending quantities be positive. This is not generally a difficulty for the computation of dividend growth except in the case of nondividend paying firms. On the other hand, many firms occasionally experience negative reported earnings, thus the geometric averaging technique can only be applied to sample firms that reported positive earnings at year-end 1981 and 1986.

5.3 Forecast Accuracy

In this study the primary metric for assessing the absolute forecast accuracy of forecast method i is the mean square forecast error (MSFE). Following Theil (1962) and Elton, Gruber, and Gultekin (1981) forecast error for forecast method i is measured as the mean of the square of the actual errors for all companies j for which that forecast was made,

$$MSFE_i = \frac{1}{N}\sum(g_{forecast\ i,j} - g_{actual,\ j})^2$$

As described in Chapter 3, there have been a number of different metrics utilized in the literature including actual error, absolute error, root mean square error, and percentage error. There is no clearly superior metric, as each has its advantages and disadvantages. The primary advantage of using the squared error and the mean square forecast error is that the MSFE can be readily decomposed

into its constituent sources of error through well known techniques.[2]

However, for the sake of completeness, the median values of the actual forecast error (AFE),

$$AFE_i = \frac{1}{N} \sum (g_{forecast\ i,\ j} - g_{actual,j}) \quad ,$$

and average absolute percentage forecast error (APFE),

$$APFE_i = \frac{1}{N} \sum \left| \frac{g_{forecast\ i,j} - g_{actual,j}}{g_{actual,\ j}} \right| \quad ,$$

by forecast method i are reported in Tables 5.1 and 5.2 below. Median, as opposed to mean, values of AFE and APFE are more representative of the sample results due to the influence a small number of extremely large errors had on the mean.[3] The reported results are based on all available observations for each forecast method. Thus, there is not a one to one correspondence of the ranks of AFE and the ranks of APFE due to differences in the number of sample companies contained in the respective final sample populations. The APFE is the more meaningful

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[2]The use of mean square error does imply that the loss incurred from an overly optimistic forecast is equivalent to the loss incurred through underforecasting. In the context of estimating the growth rate for use in determining the cost of capital, this implication seems reasonable.

[3]Eliminating only the five largest and five smallest errors, and reaveraging across the remaining sample, tended to shrink the resulting mean value by about 25 percent from the original sample mean.

metric because those results are directly comparable across methods. As indicated by the APFE, the absolute forecast accuracy of any forecasting method as evaluated at the aggregate sample level is of extremely poor. The median values indicate the forecasts missed the actual growth rate by about 100 percent on average. However, to the extent any rank ordering is meaningful at the aggregate level, the LOIBES, MNIBES, and MDIBES indicate the smallest APFE when measured against actual earnings per share growth. When errors are measured against dividend per share growth, LOIBES, H2, and H1 produced the smallest APFE. The actual errors were generally positive with the exception of the book value per share methods and mixed signs for the plowback based methods. As will be shown later, a significant portion of the magnitude of forecast error is attributable to the level of industry aggregation and industry sector aggregation, while the sign of the errors appears to be independent of industry effects. Extreme errors in certain industries had a major influence on the reported total sample results.

The MSFE by forecast method are presented in Table 5.3. The first column shows the errors computed against actual earnings per share growth and the second column of data shows the errors computed against actual dividend per share growth. The smallest MSFE for errors based on earnings growth were produced by method H1, which is the plowback method weighted over the three years prior to the

forecast date. The smallest MSFE for errors based on dividend per share growth were produced by method HB4, which is the annual rate of change in book value per share for the most recent year preceding the forecast date. However, the size of the average MSFE by forecast method is not very revealing in terms of overall accuracy, for it fails to capture other distributional properties of the errors. As will be shown, both the dispersion and skewness as well as higher moments of the error distribution tend to influence and should be considered when evaluating overall forecast performance.

Table 5.1
Accuracy of Forecasts by Historical Methods and IBES Forecasts
Over the Period January 1982 to December 1986
Error Assessed Against Actual
Growth in Earnings Per Share

Forecast Method	Actual Error (Median)	Absolute Percentage Error (Median)
HD1	2.224 %	91.336%
HD2	2.816	91.988
HD3	1.711	100.020
HD4	3.611	91.921
HE1	2.483	101.552
HE2	1.305	112.922
HE3	1.872	135.366
HE4	4.223	101.314
HB1	-3.304	92.662
HB2	-4.612	93.729
HB3	-3.955	105.570
HB4	-2.481	90.160
H1	-0.647	90.292
H2	-0.966	91.976
LOIBES	2.601	84.288
HIIBES	9.536	126.540
MNIBES	6.143	85.156
MDIBES	5.862	84.538

Table 5.2
Accuracy of Forecasts by Historical Methods and IBES Forecasts
Over the Period January 1982 to December 1986
Error Assessed Against Actual
Growth in Dividends Per Share

Forecast Method	Actual Error (Median)	Absolute Percentage Error (Median)
HD1	4.043%	100.305%
HD2	4.798	100.296
HD3	4.408	101.691
HD4	6.047	118.614
HE1	3.771	97.552
HE2	2.383	88.911
HE3	2.625	156.602
HE4	5.419	105.747
HB1	-2.784	86.050
HB2	-2.963	96.292
HB3	-0.819	109.124
HB4	-1.893	82.465
H1	0.076	76.323
H2	0.018	76.222
LOIBES	4.516	72.844
HIIBES	10.077	153.049
MNIBES	7.001	114.531
MDIBES	6.846	110.360

Table 5.3
Accuracy of Historical and IBES Methods Forecasts
Mean Square Forecast Error

	Errors Assessed Against Actual Growth In	
	Earnings	Dividends
HD1	0.04978	0.01642
HD2	0.04912	0.02574
HD3	0.05427	0.02669
HD4	0.05171	0.02572
HE1	0.05960	0.02421
HE2	0.06889	0.02369
HE3	0.06632	0.04034
HE4	0.06082	0.02395
HB1	0.04741	0.01439
HB2	0.04973	0.01753
HB3	0.07036	0.04000
HB4	0.04569	0.01358
H1	0.04414	0.01651
H2	0.04787	0.01643
LOIBES	0.04994	0.01645
HIIBES	0.08473	0.05444
MNIBES	0.05388	0.02253
MDIBES	0.05360	0.02126

Economists tend to evaluate forecasts in terms of the costs of improving the forecasting effort versus the benefits to be derived from a better forecast. However, according to Brown and Rozeff (1978), without explicit, direct information on the costs of imperfect forecasts, forecast accuracy is usually evaluated by comparing the error distributions of different distributions statistically. One method commonly employed is to normalize the MSFE to the mean square of the actual outcomes. This root of this ratio is referred to as the Theil U-statistic, and is given by

$$U_i = \left| \frac{\frac{1}{N} \sum (g_{\text{Forecast } i} - g_{\text{Actual}})^2}{\frac{1}{N} \sum (g_{\text{Actual}})^2} \right|^{1/2} .$$

This statistic implicitly compares method i's forecast to a naive no-change prediction. If method i is perfect, the resulting U-statistic is zero. If method i is at least as accurate as a no-change prediction, the U-statistic is one. And if method i is less accurate than the naive, no-change prediction, the U-statistic is greater than one. Brown and Rozeff claim that the intent of this statistic is to compare forecast accuracy of a particular method utilizing a time series of forecasts and realizations for an individual firm. An underlying assumption of the statistic is that the errors represent random draws from a

single population. Brown and Rozeff criticize studies that use the U-statistic in evaluating forecast accuracy over cross-sectional data because the errors are drawn from different distributions, potentially one for each firm in the sample. For cross-sectional data, the sampling properties of the U-statistic are not known and its meaningfulness and interpretation are questionable.[4] In addition to this criticism, it should also be noted that no procedure is available with tests of significance which uses the U-statistic to compare two competing forecast methods when neither is a no-change method. With these caveats in mind, the computed U-statistics by forecast method are presented in Table 5.4. Rank ordering of the statistics as presented in Cragg and Malkiel or Elton and Gruber is not appropriate because it is indeterminate as to whether the differences in computed values are statistically significant at any meaningful level. A more powerful and efficient test of forecast accuracy over cross-sectional data that are (possibly) drawn from several unknown distributions is attributable to Wilcoxon (1945). This test allows hypothesis tests of two forecasts by using a one-sample or matched-pair design, where the data are self-paring by firms. The

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[4]A partial remedy for this criticism in cross-sectional studies is to compute the statistic by industry group under the assumption that the distributions of errors within an industry are more similar than the distributions across the entire population.

competing forecast errors for each firm are reduced to a single value by taking the difference in the MSFE of methods i and j. Conventionally, the parametric t-statistic would

Table 5.4
Accuracy of Historical and IBES Methods Forecasts
Theil's U-Statistic

Forecast Method	Errors Assessed Against Actual Growth in: Earnings	Dividends
HD1	0.83139	1.36253
HD2	0.89177	1.66615
HD3	0.99628	1.73315
HD4	0.88748	1.53253
HE1	1.14436	1.57364
HE2	1.32620	1.53300
HE3	1.14825	2.34635
HE4	1.16012	1.56749
HB1	0.95024	0.96873
HB2	0.99537	1.18049
HB3	1.38145	2.64500
HB4	0.88894	0.89456
H1	0.80931	1.01602
H2	0.92156	1.05326
LOIBES	1.00089	1.10773
HIIBES	1.69833	3.66583
MNIBES	1.07995	1.51725
MDIBES	1.07439	1.43184

be utilized to test for significance in the mean error differences. However, that parametric test seems inappropriate since it can not be assured that all observations are being drawn from the same distribution, and therefore, it cannot be assumed that variances are homogeneous. In the case of unknown or multiple distributions, the Wilcoxon Signed Ranks test makes the most efficient use of the sample information. Even in large samples, Conover (1980) makes special reference to

the power of the Wilcoxon Signed Ranks test over the parametric t test when the sample population is discrete and contains relatively very small and very large observations. These conditions are inherent in the data in this examination. Another attractive property of the Wilcoxon Signed Ranks test is that it is insensitive to error definition, thus whether or not squared errors are the most desirable and interesting error metric is not an issue.

The Wilcoxon test proceeds in the following fashion. First, the absolute differences (without regard to sign) of the squared errors of methods i and j, are defined as $D_{k,ij}$,

$$D_{k,ij} = \left| E_{k,i} - E_{k,j} \right| ,$$

for all firms k with observations for both method i and j. For all $D_{k,ij} = 0$, the observations are omitted from further consideration. The remaining m observations are ranked ordered from 1 to m, with rank 1 being given to the smallest absolute difference, rank 2 given to the next smallest difference, and so on. In the case of ties, the average of the ranks that would have been given is assigned to all tied observations. Next, if the sign of the difference in the actual squared errors was positive, the respective rank is assigned a positive sign, and if the actual error difference was negative, the respective rank is assigned a negative sign. Finally, the following test statistic is computed over the signed ranks, $R_{m,ij}$,

$$T_{ij} = \frac{\sum R_{m,ij}}{\sum (R_{m,ij})^2}$$

Because it is the interest of this study to determine the relative forecast accuracy of the IBES based methods against the historically based methods, the statistic T_{ij} is computed for each of the IBES based methods in contrast to each of the historically based methods. Comparisons among the historically based methods themselves have not been computed. The formal set of hypotheses of each test are as follows,

H_0: The median difference between the squared forecast error of historical forecast method i and IBES forecast j is equal to zero.

$$H_0: \quad E_i - E_j = 0$$

H_A: The median difference between the squared forecast error of historical forecast method i and IBES forecast j is not equal to zero.

$$\begin{aligned} H_{A1}&: \quad E_i - E_j > 0 \\ \text{or } H_{A2}&: \quad E_i - E_j < 0 \end{aligned}$$

The decision rule for this test is to accept the null hypothesis for small absolute values of T_{ij}. For large positive or large negative values of T_{ij}, the null hypothesis is rejected. If the T_{ij} is negative, the indication is that the forecasts by historical methods produced smaller errors than the IBES forecast, and vice versa if T_{ij} is positive. The results for the aggregate sample population are presented in Table 5.5 when errors were measured against actual earnings growth

and in Table 5.6 when errors were measured against actual dividend growth.

In Table 5.5, the raw comparisons of the LOIBES forecasts with the forecasts by historical methods indicate that 10 out of the 14 comparisons were positively signed. That is, in ten pairwise comparisons of MSFE,

Table 5.5
Accuracy of Historical Methods Vs. IBES Forecasts
Wilcoxon Signed Ranks Tests
Errors Assessed Against Actual Earnings Growth

	LOIBES T_{ij}	HIIBES T_{ij}	MNIBES T_{ij}	MDIBES T_{ij}
HD1	4.6056 **	-2.5347 *	2.7807 **	3.3014**
HD2	3.7979 **	-3.7594 **	1.1680	1.6215
HD3	3.3051 **	-3.5172 **	0.8637	1.2575
HD4	6.1997 **	-0.9894	4.5009 **	4.8072**
HE1	7.5774 **	-1.7846	4.0201 **	4.5618**
HE2	5.7987 **	-2.5870 **	2.2700 *	2.5693 *
HE3	7.9180 **	3.0845 **	6.2815 **	6.5785**
HE4	8.0678 **	-1.7447	4.6248 **	5.4254**
HB1	-1.5962	-6.5237 **	-3.4735 **	-3.3266**
HB2	-0.2521	-5.6543 **	-2.5602 *	-2.2690 *
HB3	5.6444 **	-1.0136	2.8646 **	3.3213**
HB4	-2.3410 *	-6.9639 **	-3.9146 **	-3.6958**
H1	1.1370	-6.6893 **	-3.2592 **	-2.9531**
H2	-7.2195 **	-11.2070 **	-9.4451 **	-9.1289**

* Indicates significance at the a=.05 level.
** Indicates significance at the a=.01 level.

the LOIBES indicated the smaller forecast error. Statistically, the null hypothesis was rejected in 10 cases, with 9 of the 14 comparisons indicating a significantly positive error and 1 of the 14 comparisons indicating a significantly negative error. The inference from this set of comparisons is that the LOIBES method was

a more accurate forecasting methodology than the historical methods in general.[5]

The next column of Table 5.5 compares the HIIBES forecast with the forecasts by historical methods. In these comparisons, the computed statistics were negatively signed in thirteen of the fourteen pairwise tests. Nine comparisons indicated statistically significant negative differences while only one comparison was significantly positive. These tests indicate that at the aggregate sample level, the HIBES forecasts were generally less accurate than the forecasts by historical methods.

In the third column of Table 5.5 the MNIBES forecasts are compared to theforecasts by historical methods. Nine of the fourteen comparisons are positively signed, and seven of the nine positive statistics are significantly different from zero, thus there is a slight indication that the MNIBES forecasts were more accurate than the forecasts by historical methods.

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[5]To avoid the introduction of ex post selection bias, the tests are interpreted as comparing a particular IBES method with the full set of historical methods. That is, after the fact, there will most likely always be an historical method that produced lower MSFE for a firm, an industry, or the sample. However, from an ex ante perspective, it is difficult to imagine that that correct choice would have always been made. The LOIBES and HIIBES methods have been included for completeness, however, it is nearly always the case that either MDIBES or MNIBES is used in cost of capital studies. Thus, ex post selection bias is only at issue for the IBES methods in an after the fact choice of MDIBES or MNIBES as the better methodology. If it shown that both of these methods produce statistically different results than the historical methods, then that issue can be avoided.

The fourth column of Table 5.5 displays the results of comparing the MDIBES forecasts with the forecasts by historical methods. As with the MNIBES, nine of the fourteen comparisons are positively signed, with seven of those being significantly different from zero. Five of the comparisons were significantly less than zero. These results support weakly the inference that the MDIBES forecasts were more accurate than the forecasts by historical methods at the aggregate sample level.

In Table 5.6, where the comparisons are based on squared errors assessed against actual dividend growth, the comparisons of the LOIBES forecasts with the forecasts by historical methods indicate that ten of the fourteen comparisons were positively signed, with nine of those ten being significantly greater than zero. The inference from this set of comparisons is that the LOIBES method was a more accurate method of forecasting dividend growth than the forecasts by historical methods in general.

The next column of Table 5.6 compares the HIIBES forecast with the forecasts by historical methods. In these comparisons, the computed statistics were negatively signed in thirteen of the fourteen pairwise tests, and all thirteen were statistically significant negative differences. These tests indicate that at the aggregate sample level, the HIIBES forecasts were generally less

accurate than the forecasts by historical methods in producing forecasts of dividend growth.

The third column of Table 5.6, the MNIBES forecasts are compared to the forecasts by historical methods. Twelve of the fourteen comparisons are negatively signed, and seven of the twelve negative statistics are significantly different from zero. Thus, at the aggregate sample level, there is weak evidence that the MNIBES forecasts were less accurate

Table 5.6
Accuracy of Historical Methods Vs. IBES Forecasts
Wilcoxon Signed Ranks Tests
Errors Assessed Against Actual Dividend Growth

	LOIBES T_{ij}	HIIBES T_{ij}	MNIBES T_{ij}	MDIBES T_{ij}
HD1	5.9921 **	-10.0590 **	-2.3903 *	-1.4218
HD2	6.8516 **	-9.8092 **	-1.8639	-1.0170
HD3	5.8943 **	-8.8325 **	-0.5722	0.0977
HD4	10.5049 **	-7.2155 **	2.2108 *	3.2738**
HE1	5.4275 **	-11.2180 **	-2.4541 *	-1.7350
HE2	4.7789 **	-9.4613 **	-1.9395	-1.2065
HE3	13.3271 **	3.7010 **	9.7376 **	10.1476**
HE4	8.7634 **	-10.3520 **	-0.5357	0.5038
HB1	-2.0522 *	-13.8550 **	-8.4611 **	-7.8180**
HB2	0.9178	-10.7300 **	-5.1240 **	-4.4527**
HB3	4.8021 **	-5.7115 **	-0.3617	0.2477
HB4	-2.1480 *	-14.1240 **	-8.7768 **	-8.0945**
H1	-1.1753	-14.1250 **	-8.9520 **	-8.4332**
H2	-8.1159 **	-18.2710 **	-14.7060 **	-14.229**

* Indicates significance at the a=.05 level.
** Indicates significance at the a=.01 level.

than the forecasts by historical methods in terms of dividend growth forecasts.

The fourth column of Table 5.6 shows the results of comparing the MDIBES forecasts with the forecasts by historical methods. In this set of tests, five of the

comparisons indicated positive statistics and nine indicated negative statistics. Of the five positives, only two were significantly different from zero, and of the nine negatives, only five were significantly different from zero. Thus, these results are decidedly mixed and provide no indication of forecast superiority at the aggregate sample level of either MDIBES or the forecasts by historical methods. That is, the null hypothesis of equivalent errors can not be rejected.

5.4 Forecast Accuracy Within Industrial Categories

When both earnings growth and dividend growth errors are considered, the results presented above tend to indicate that there is very little difference in the forecast accuracy of the IBES or forecasts by historical methods at the aggregate sample level. This is especially true if the IBES forecasts are limited to MNIBES and MDIBES, as is normally done. However, as noted in the data descriptions presented in Chapter 4, there are significant differences among the industry groupings in terms of the distributions of historical and IBES forecasts. Thus, it should also be expected that the distribution of forecast errors will be different among the industry groupings and while there is no clear-cut evidence of forecast method dominance at the aggregate level, such dominance may exist at the industry level.

this section examines forecast accuracy by industry category[6].

In Tables 5.7 through 5.10 below, the median actual error and median absolute percentage error are shown by forecast method and industry category for forecast errors measured against actual earnings growth and actual dividend growth. Although there is significant dispersion in the error values, even casual inspection indicates that the forecast errors are much more similar within an industry than within a method. For example, the average coefficient of variation of absolute percentage errors based on earnings growth is .7218 within methods, but only .2924 within industries. That is, the variation in the average APFE for a particular forecast method is about 2.5 times greater than the variation of the average APFE for a particular industry. This, in turn, makes it difficult, if not entirely misleading, to draw general conclusions regarding forecast accuracy and preferred forecasting methodology from the aggregate sample results. This is because a method or methods may be significantly more accurate than other methods within a particular industry but may be highly inaccurate within other industries.

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[6]Three industry groups that were analyzed in Chapter 4 have been eliminated in this analysis due to the small number of observations that remained after the actual growth rates were computed. Those industry groups are Communications, Construction and Office Equipment.

In general, the pattern of forecast errors reported in Tables 5.8 and 5.9 tend to contradict the findings of Cragg and Malkiel (1982) regarding the relative ease of forecasting the growth of particular industries. Cragg and Malkiel found, contrary to intuition, that the Electric Utility industry proved to be one of the more difficult industries to predict, while the Petroleum Refining group was among the more correctly forecasted industries. The results reported here indicate just the reverse. The Utility group demonstrates the smallest APFE on average across both the historical and IBES forecast methods, while the Petroleum Refining industry has the largest average APFE across forecast methods. The contrasting results may be the manifestation of the significantly different sample composition, in that Cragg and Malkiel were limited to an analysis of large, mature firms.

Figures 5.1 and 5.2 help to summarize the industry grouping MSFE reported in Appendices 6 and 7. Figure 5.1 shows the average historical method MSFE computed on the basis of actual earnings growth contrasted with the equivalent average IBES MSFE for each industry grouping. In fourteen of the 24 industries the average MSFE for IBES based methods is less than the average MSFE of the forecasts by historical methods. In Figure 5.2, the MSFE assessed on the basis of actual dividend growth are shown. In these comparisons of average historical method MSFE and

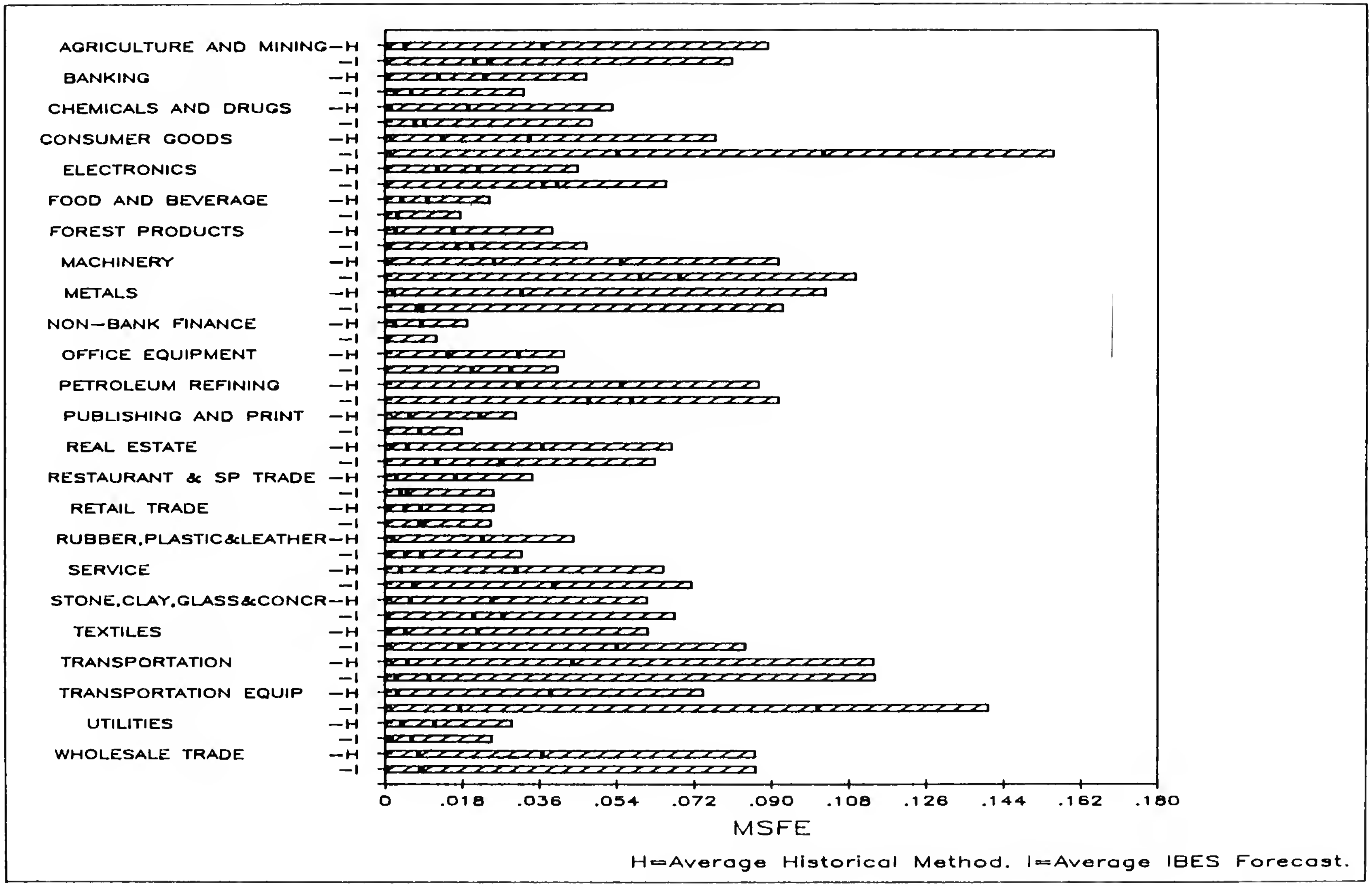

Figure 5.1
Comparision of Forecast Errors
Errors Assessed Against Actual Earnings Growth

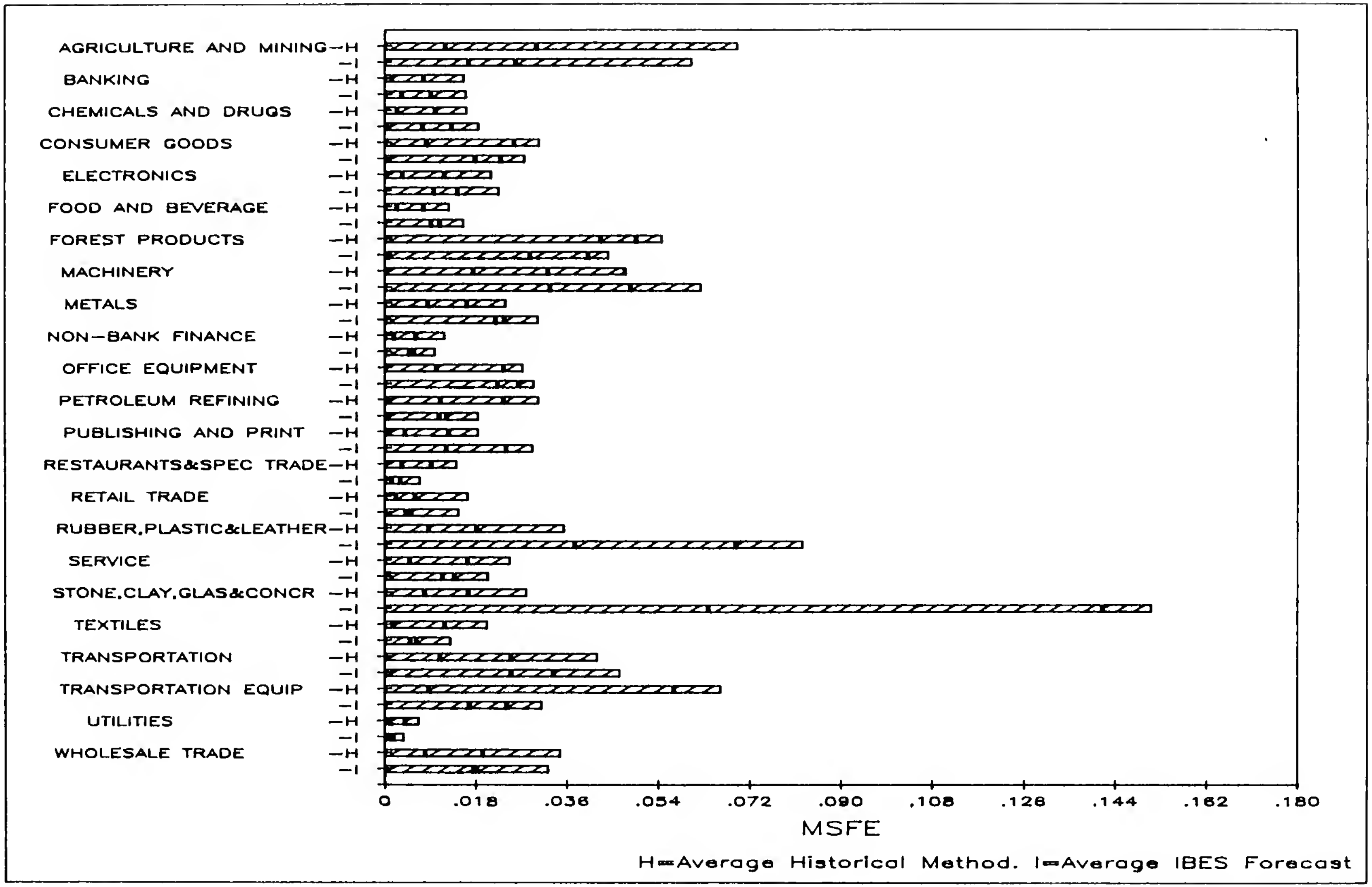

Figure 5.2
Comparision of Forecast Errors
Errors Assessed Against Actual Dividend Growth

average IBES method MSFE, twelve of the twenty three industry group comparisons indicate smaller errors for the IBES methods.

An examination of the Wilcoxon Signed Ranks statistics shown in Appendices 8 and 9, tends to reinforce the view of an industrial category effect on the distribution of forecast errors. As before, the Wilcoxon statistics are computed on the differences in squared forecast errors between the indicated historical method and the indicated IBES method. The voluminous amount of data makes visual inspection of Appendices 7 and 8 difficult. Tables 5.11 and 5.12 help to summarize those findings and aid in the interpretation of the forecast accuracy results.

In the computation of the Wilcoxon Signed Ranks within each industry, fourteen historical methods were tested for equivalence in forecast error with each of the four IBES methods. The columns in Tables 5.11 and 5.12 represent the number of times that the Wilcoxon statistic was significantly positive (the columns labeled by a plus sign), or significantly negative (the columns labeled by a minus sign). Recall that a positive value indicates the IBES method produced smaller errors while a negative value indicates the forecasts by historical methods produced smaller errors.

As shown in Table 5.11, in two industries, Banking and Utilities, the IBES forecasts were clearly more

Table 5.7
Median Actual Errors for Forecasts by Historical Methods and IBES Forecasts
Errors Are Assessed Against Actual Earnings Growth

	HD1	HD2	HD3	HD4	HE1	HE2	HE3
AGRICULTURE AND MINING	0.0286	0.0738	0.0529	0.1087	0.0655	0.0690	0.0443
BANKING	-0.1256	-0.1149	-0.0587	-0.1143	-0.0938	-0.0564	-0.1129
CHEMICALS AND DRUGS	0.0350	0.0394	0.0277	0.0492	0.0461	0.0287	0.0002
CONSUMER GOODS	0.2288	0.2299	0.1564	0.2757	0.1751	0.1431	0.1355
ELECTRONICS	0.1341	0.1242	0.1035	0.1356	0.1588	0.0964	0.0626
FOOD AND BEVERAGE	0.0056	-0.0163	0.0224	0.0209	0.0152	-0.0179	0.0115
FOREST PRODUCTS	0.0905	0.0703	0.0318	0.0763	0.0672	0.0325	0.0246
MACHINERY	0.2303	0.2112	0.1898	0.2383	0.2236	0.2029	0.1253
METALS	0.0880	0.0977	0.0635	0.0969	0.0634	0.0419	0.0260
NON-BANK FINANCE	0.0507	0.0478	0.0296	0.0770	0.0087	-0.0002	-0.0851
PETROLEUM REFINING	0.2322	0.2406	0.2390	0.2583	0.2745	0.3039	0.0397
PUBLISHING AND PRINT	-0.0152	-0.0095	-0.0470	-0.0054	-0.0060	-0.0248	-0.0156
REAL ESTATE	-0.0285	0.1379	0.0095	-0.0386	0.0470	0.2337	0.0249
RESTAURANTS AND SPEC TRADE	0.1345	0.1274	0.0631	0.1480	0.0004	-0.0056	0.0050
RETAIL TRADE	0.1155	0.1071	0.1198	0.1474	0.0800	0.0659	0.0295
RUBBER, PLASTIC, AND LEATHER	-0.0473	0.0275	-0.0062	-0.0371	0.0337	-0.0144	0.1595
SERVICE	0.1122	0.1200	0.0588	0.1342	0.1056	0.0335	0.0498
SOCIAL SERVICES	0.1478	0.1817	0.1711	0.1472	0.1585	0.1270	0.1191
STONE,CLAY,GLASS, AND CONCRETE	0.1150	0.1293	0.0735	0.1237	0.1503	0.0799	-0.0770
TEXTILES	0.0782	0.0548	0.0854	0.0882	0.0952	0.0963	0.1193
TRANSPORTATION	0.0366	0.0485	0.1206	0.0340	0.0567	-0.0465	-0.0112
TRANSPORTATION EQUIP	0.0246	0.0432	-0.0369	0.0479	0.0182	-0.0151	-0.0957
UTILITIES	-0.0736	-0.0689	-0.0541	-0.0679	-0.0845	-0.0699	0.0078
WHOLESALE TRADE	0.0517	0.0958	0.0856	0.1304	0.0851	0.0812	0.0813

Table 5.7--continued

	HE4	HB1	HB2	HB3	HB4	H1	H2
AGRICULTURE AND MINING	0.1765	-0.0062	-0.0398	-0.0088	0.0266	0.0497	0.0721
BANKING	-0.0834	-0.1399	-0.1193	-0.0951	-0.1437	-0.1200	-0.1126
CHEMICALS AND DRUGS	0.0554	-0.0227	-0.0153	-0.0254	0.0012	0.0022	-0.0017
CONSUMER GOODS	0.2094	0.1131	0.0556	0.0356	0.1162	0.1456	0.1621
ELECTRONICS	0.1401	0.0275	0.0483	0.0434	0.0545	0.0856	0.0889
FOOD AND BEVERAGE	0.0288	-0.0710	-0.0480	-0.0627	-0.0548	-0.0458	-0.0480
FOREST PRODUCTS	0.0542	0.0096	0.0266	-0.0045	0.0015	0.0526	0.0281
MACHINERY	0.2380	0.1065	0.1191	0.0774	0.0935	0.2084	0.2196
METALS	0.0866	0.0166	-0.0069	-0.0031	0.0123	0.1015	0.0778
NON-BANK FINANCE	0.0375	-0.0371	-0.0574	-0.0385	-0.0279	-0.0343	-0.0415
PETROLEUM REFINING	0.2525	0.1024	0.1112	0.1377	0.1380	0.2521	0.2436
PUBLISHING AND PRINT	0.0069	-0.0532	-0.0988	-0.0339	-0.0414	-0.0836	-0.0904
REAL ESTATE	0.0168	-0.0149	-0.0087	-0.0010	-0.0039	0.1244	0.0092
RESTAURANTS AND SPEC TRADE	0.0545	0.0036	-0.0149	0.0095	0.0047	-0.0261	-0.0280
RETAIL TRADE	0.0918	0.0227	-0.0541	0.0465	0.0362	0.0440	0.0410
RUBBER, PLASTIC, AND LEATHER	0.0736	0.0179	-0.0170	-0.0258	0.0107	0.0073	0.0261
SERVICE	0.1222	-0.0058	-0.0211	-0.0672	-0.0133	0.0646	0.0452
SOCIAL SERVICES	0.1380	-0.1287	-0.1441	-0.1889	-0.1253	0.0131	0.0296
STONE,CLAY,GLASS, AND CONCRETE	0.1454	0.0587	0.0518	0.0738	0.0505	0.1252	0.1011
TEXTILES	0.1098	0.0715	0.0772	0.0609	0.0806	0.0552	0.0602
TRANSPORTATION	0.0815	-0.0405	-0.0306	-0.0063	-0.0126	0.0302	-0.0200
TRANSPORTATION EQUIP	0.0590	-0.0273	-0.0388	-0.0366	-0.0113	0.0408	0.0314
UTILITIES	-0.0791	-0.1061	-0.1092	-0.1025	-0.1038	-0.0931	-0.0870
WHOLESALE TRADE	0.1147	-0.0207	-0.0639	-0.0326	-0.0076	0.0091	-0.0039

Table 5.7--continued

	LOIBES	HIIBES	MNIBES	MDIBES
AGRICULTURE AND MINING	0.1416	0.1917	0.1541	0.1541
BANKING	-0.0745	-0.0446	-0.0521	-0.0517
CHEMICALS AND DRUGS	0.0495	0.1186	0.0779	0.0811
CONSUMER GOODS	0.1982	0.2650	0.2254	0.2207
ELECTRONICS	0.1497	0.2044	0.1633	0.1536
FOOD AND BEVERAGE	-0.0103	0.0296	0.0036	0.0011
FOREST PRODUCTS	0.0555	0.2069	0.1261	0.1046
MACHINERY	0.2104	0.2739	0.2625	0.2639
METALS	0.0710	0.1482	0.1275	0.1275
NON-BANK FINANCE	-0.0165	0.0684	0.0235	0.0249
PETROLEUM REFINING	0.2010	0.3050	0.2623	0.2680
PUBLISHING AND PRINT	-0.0172	0.0138	-0.0108	-0.0142
REAL ESTATE	0.0696	0.1625	0.0958	0.0958
RESTAURANTS AND SPEC TRADE	0.0093	0.0543	0.0339	0.0381
RETAIL TRADE	0.0753	0.0953	0.0843	0.0853
RUBBER, PLASTIC, AND LEATHER	0.0788	0.1269	0.1058	0.1058
SERVICE	0.0627	0.1183	0.0694	0.0702
SOCIAL SERVICES	-0.0267	0.1281	0.1051	0.0983
STONE,CLAY,GLASS, AND CONCRETE	0.0622	0.1822	0.1222	0.1222
TEXTILES	0.0884	0.1134	0.0984	0.0959
TRANSPORTATION	0.0110	0.1785	0.0500	0.0423
TRANSPORTATION EQUIP	0.0533	0.1809	0.1129	0.0902
UTILITIES	-0.0846	-0.0544	-0.0729	-0.0723
WHOLESALE TRADE	0.0789	0.1329	0.0952	0.0965

Table 5.8
Median Absolute Percentage Errors for Forecasts by Historical Methods and IBES Forecasts
Errors Are Assessed Against Actual Earnings Growth

	HD1	HD2	HD3	HD4	HE1	HE2	HE3
AGRICULTURE & MINING	1.253	1.236	1.000	1.296	1.323	1.369	1.935
BANKING	0.792	0.749	0.694	0.796	0.694	0.651	0.958
CHEMICALS AND DRUGS	1.055	1.055	1.000	1.228	1.002	0.951	1.317
CONSUMER GOODS	1.763	1.475	1.375	2.964	1.683	1.603	1.563
ELECTRONICS	2.242	1.925	1.333	1.835	1.802	1.624	2.286
FOOD AND BEVERAGE	0.488	0.663	0.760	0.495	0.588	0.709	0.632
FOREST PRODUCTS	1.303	0.938	1.000	1.289	1.564	1.894	1.525
MACHINERY	1.662	1.423	1.261	1.663	1.542	1.716	1.571
METALS	1.767	1.629	1.257	1.838	1.295	1.458	1.643
NON-BANK FINANCE	1.309	1.000	0.804	1.140	0.632	0.714	1.361
PETROLEUM REFINING	7.029	1.773	11.565	8.101	5.467	4.962	21.451
PUBLISHING AND PRINT	1.609	1.634	1.835	1.548	1.737	1.710	1.019
REAL ESTATE	0.674	1.439	1.000	1.416	1.148	2.022	1.548
RESTAURANTS AND SPEC TRADE	1.605	1.903	1.000	1.842	0.498	1.045	0.577
RETAIL TRADE	1.903	1.752	1.665	1.810	1.991	1.351	1.142
RUBBER, PLASTIC, AND LEATHER	0.674	0.873	1.000	0.784	1.014	1.467	2.832
SERVICE	2.256	1.453	1.744	1.984	1.423	1.598	2.515
SOCIAL SERVICES	3.743	2.714	3.052	4.339	2.238	2.184	3.097
STONE,CLAY,GLASS, AND CONCRETE	1.280	1.241	1.000	1.321	1.291	1.275	1.588
TEXTILES	1.101	1.267	1.566	1.158	1.725	1.351	2.093
TRANSPORTATION	0.862	0.983	1.353	0.632	1.003	1.381	1.581
TRANSPORTATION EQUIP	0.856	1.339	1.244	1.046	1.714	1.643	3.777
UTILITIES	0.754	0.747	0.712	0.736	0.844	0.866	1.060
WHOLESALE TRADE	1.000	1.796	1.093	1.547	1.349	1.227	1.683

Table 5.8--continued

	HE4	HB1	HB2	HB3	HB4	H1	H2
AGRICULTURE & MINING	1.392	1.029	0.972	1.238	0.903	1.086	1.048
BANKING	0.674	0.865	0.738	0.659	0.846	0.841	0.838
CHEMICALS AND DRUGS	1.058	0.899	0.660	1.036	0.938	0.800	0.793
CONSUMER GOODS	1.788	1.136	0.948	1.407	1.152	1.318	1.327
ELECTRONICS	1.970	0.989	1.246	1.315	1.141	1.386	1.280
FOOD AND BEVERAGE	0.574	0.905	1.006	0.569	0.906	0.763	0.773
FOREST PRODUCTS	1.259	0.862	1.005	1.075	0.782	1.424	1.422
MACHINERY	1.791	1.024	1.115	1.422	1.068	1.426	1.461
METALS	1.497	1.009	0.839	1.207	1.009	1.475	1.353
NON-BANK FINANCE	0.633	0.718	0.781	0.687	0.646	0.837	0.724
PETROLEUM REFINING	5.687	0.981	3.871	4.384	1.700	5.296	5.874
PUBLISHING AND PRINT	1.549	0.892	0.992	1.750	0.973	1.587	1.622
REAL ESTATE	1.297	0.993	0.934	0.991	0.988	1.066	0.998
RESTAURANTS AND SPEC TRADE	0.559	0.629	0.592	0.336	0.615	0.786	0.904
RETAIL TRADE	1.977	1.016	0.696	1.235	1.056	1.276	1.302
RUBBER, PLASTIC, AND LEATHER	1.307	0.881	0.761	1.087	0.767	0.901	0.979
SERVICE	1.329	1.088	0.893	1.467	0.944	0.941	1.274
SOCIAL SERVICES	1.817	0.964	1.120	1.242	1.004	0.801	0.845
STONE,CLAY,GLASS, AND CONCRETE	1.267	1.097	0.904	1.207	1.096	1.214	1.166
TEXTILES	1.066	1.420	1.569	1.338	1.380	1.438	1.465
TRANSPORTATION	0.946	0.993	0.784	1.039	0.812	1.107	0.980
TRANSPORTATION EQUIP	1.536	1.048	1.178	1.230	0.896	1.372	0.985
UTILITIES	0.817	0.932	0.966	0.991	0.905	0.821	0.843
WHOLESALE TRADE	1.403	1.002	1.136	1.561	0.811	0.902	0.854

Table 5.8--continued

	LOIBES	HIIBES	MNIBES	MDIBES
AGRICULTURE & MINING	1.272	1.854	1.511	1.444
BANKING	0.600	0.618	0.586	0.594
CHEMICALS AND DRUGS	0.795	1.469	1.140	1.167
CONSUMER GOODS	1.620	2.449	1.747	1.747
ELECTRONICS	1.668	2.710	2.076	1.771
FOOD AND BEVERAGE	0.553	0.486	0.514	0.514
FOREST PRODUCTS	1.105	2.250	1.782	1.802
MACHINERY	1.517	2.049	1.771	1.767
METALS	1.400	2.123	1.644	1.618
NON-BANK FINANCE	0.552	0.562	0.552	0.528
PETROLEUM REFINING	7.459	7.459	7.459	7.459
PUBLISHING AND PRINT	1.414	1.783	1.567	1.599
REAL ESTATE	1.481	1.481	1.481	1.481
RESTAURANTS AND SPEC TRADE	0.603	0.597	0.501	0.615
RETAIL TRADE	1.548	1.822	1.680	1.643
RUBBER, PLASTIC, AND LEATHER	1.485	2.393	1.692	1.663
SERVICE	1.350	1.350	1.350	1.350
SOCIAL SERVICES	0.760	1.437	1.377	1.377
STONE,CLAY,GLASS, AND CONCRETE	1.191	1.654	1.384	1.312
TEXTILES	1.663	2.443	1.933	1.762
TRANSPORTATION	0.786	1.139	0.865	0.835
TRANSPORTATION EQUIP	0.981	1.547	1.375	1.311
UTILITIES	0.775	0.606	0.692	0.702
WHOLESALE TRADE	1.197	1.550	1.370	1.393

Table 5.9
Median Actual Errors for Forecasts by Historical Methods and IBES Forecasts
Errors Are Assessed Against Actual Dividend Growth

	HD1	HD2	HD3	HD4	HE1	HE2	HE3
AGRICULTURE AND MINING	0.0200	0.0880	0.1187	0.1458	0.0937	0.0607	-0.0176
BANKING	-0.0094	0.0121	0.0272	-0.0120	0.0169	0.0403	0.0177
CHEMICALS AND DRUGS	0.0222	0.0315	0.0293	0.0370	0.0379	0.0162	-0.0193
CONSUMER GOODS	0.0753	0.0837	0.0776	0.0869	0.0791	0.0300	0.0487
ELECTRONICS	0.0444	0.0534	0.0353	0.0594	0.0477	0.0207	0.0343
FOOD AND BEVERAGE	0.0238	0.0198	0.0442	0.0408	0.0316	0.0103	0.0378
FOREST PRODUCTS	0.0763	0.0814	0.0683	0.0997	0.0995	0.0626	-0.0189
MACHINERY	0.1084	0.1275	0.1268	0.1494	0.1405	0.1205	0.0480
METALS	0.1294	0.1054	0.0646	0.1569	0.1087	0.0602	0.0231
NON-BANK FINANCE	0.0583	0.0833	0.0492	0.0754	0.0227	0.0001	-0.0477
PETROLEUM REFINING	0.1046	0.0998	0.1289	0.1042	0.1227	0.1187	-0.0756
PUBLISHING AND PRINT	0.0462	0.0210	-0.0036	0.0496	0.0229	-0.0066	0.0092
REAL ESTATE	-0.0243	0.1285	0.0686	-0.0381	-0.0105	0.0240	0.0347
RESTAURANTS AND SPEC TRADE	0.0501	0.0009	-0.0174	0.0511	-0.0016	-0.0070	0.0607
RETAIL TRADE	0.0402	0.0204	0.0088	0.0596	0.0281	-0.0210	0.0153
RUBBER, PLASTIC, AND LEATHER	0.0549	0.0730	0.0287	0.0883	0.0457	0.0389	0.1297
SERVICE	0.1165	0.0947	0.0596	0.1271	0.0607	0.0293	0.0500
SOCIAL SERVICES	0.1268	0.1206	0.0922	0.1431	0.0633	0.0809	0.1056
STONE,CLAY,GLASS, AND CONCRETE	0.0568	0.0899	0.0780	0.0654	0.0646	0.0713	-0.0391
TEXTILES	0.0097	0.0065	0.0449	0.0099	0.0159	0.0341	0.1687
TRANSPORTATION	0.0713	0.0892	0.1230	0.1123	0.0796	0.0595	0.0082
TRANSPORTATION EQUIP	0.0595	0.0432	0.0179	0.0942	0.0893	0.0148	-0.0259
UTILITIES	-0.0076	0.0002	0.0166	-0.0023	-0.0118	0.0002	0.0648
WHOLESALE TRADE	0.0523	0.0981	0.0738	0.0997	0.0845	0.0576	0.0429

Table 5.9--continued

	HE4	HB1	HB2	HB3	HB4	H1	H2
AGRICULTURE AND MINING	0.2045	-0.0435	-0.0548	-0.0248	0.0292	0.0673	0.0695
BANKING	0.0283	-0.0385	-0.0370	-0.0108	-0.0345	-0.0169	-0.0201
CHEMICALS AND DRUGS	0.0451	-0.0135	-0.0149	-0.0202	-0.0173	-0.0047	-0.0025
CONSUMER GOODS	0.0918	-0.0076	0.0073	0.0090	0.0113	0.0436	0.0490
ELECTRONICS	0.0576	-0.0146	-0.0266	0.0096	0.0003	0.0015	-0.0002
FOOD AND BEVERAGE	0.0417	-0.0457	-0.0352	-0.0088	-0.0515	-0.0139	-0.0111
FOREST PRODUCTS	0.0951	0.0153	0.0437	0.0341	0.0341	0.0387	0.0318
MACHINERY	0.1436	0.0462	0.0299	0.0315	0.0379	0.0856	0.1080
METALS	0.1010	0.0148	-0.0020	0.0555	0.0123	0.0847	0.0743
NON-BANK FINANCE	0.0530	-0.0374	-0.0015	-0.0042	-0.0119	-0.0194	-0.0175
PETROLEUM REFINING	0.1201	-0.0061	-0.0313	0.0748	-0.0069	0.0748	0.0887
PUBLISHING AND PRINT	0.0362	-0.0624	-0.0801	-0.0500	-0.0383	-0.0693	-0.0692
REAL ESTATE	0.0088	-0.0633	-0.0475	-0.0499	-0.0656	-0.0173	-0.0174
RESTAURANTS AND SPEC TRADE	0.0055	-0.0799	-0.0681	0.0073	-0.0671	-0.0984	-0.0969
RETAIL TRADE	0.0393	-0.0333	-0.0632	-0.0407	-0.0326	-0.0417	-0.0442
RUBBER, PLASTIC, AND LEATHER	0.0313	0.0191	0.0029	0.0332	0.0267	0.0081	0.0127
SERVICE	0.0850	-0.0150	-0.0136	-0.0038	-0.0045	-0.0238	-0.0229
SOCIAL SERVICES	0.0639	-0.1296	-0.1898	-0.2604	-0.1168	-0.0807	-0.0857
STONE,CLAY,GLASS, AND CONCRETE	0.0660	-0.0094	0.0112	0.0374	-0.0075	0.0384	0.0309
TEXTILES	0.0071	-0.0116	-0.0064	0.0322	-0.0096	0.0095	0.0122
TRANSPORTATION	0.0968	0.0342	0.0145	0.0948	0.0470	0.0424	0.0521
TRANSPORTATION EQUIP	0.1073	-0.0240	-0.0458	-0.0161	-0.0482	0.0172	0.0025
UTILITIES	-0.0103	-0.0340	-0.0375	-0.0319	-0.0306	-0.0161	-0.0128
WHOLESALE TRADE	0.0984	-0.0200	-0.0471	-0.0199	-0.0007	0.0032	0.0019

Table 5.9--continued

	LOIBES	HIIBES	MNIBES	MDIBES
AGRICULTURE AND MINING	0.1006	0.1782	0.1421	0.1429
BANKING	0.0262	0.0586	0.0427	0.0402
CHEMICALS AND DRUGS	0.0452	0.1091	0.0718	0.0724
CONSUMER GOODS	0.0951	0.1766	0.1362	0.1171
ELECTRONICS	0.0596	0.1177	0.0909	0.0904
FOOD AND BEVERAGE	0.0387	0.0573	0.0507	0.0512
FOREST PRODUCTS	0.0540	0.1401	0.1114	0.0996
MACHINERY	0.1157	0.2059	0.1838	0.1647
METALS	0.0911	0.1720	0.1200	0.1195
NON-BANK FINANCE	0.0203	0.0637	0.0357	0.0394
PETROLEUM REFINING	0.0664	0.1453	0.1039	0.1009
PUBLISHING AND PRINT	0.0140	0.0503	0.0193	0.0193
REAL ESTATE	0.0503	0.0623	0.0534	0.0534
RESTAURANTS AND SPEC TRADE	0.0134	0.0413	0.0326	0.0363
RETAIL TRADE	0.0137	0.0809	0.0462	0.0391
RUBBER, PLASTIC, AND LEATHER	0.0701	0.1375	0.1092	0.1092
SERVICE	0.0693	0.1113	0.0953	0.0928
SOCIAL SERVICES	0.0305	0.1256	0.0917	0.0838
STONE,CLAY,GLASS, AND CONCRETE	0.0629	0.1846	0.1262	0.1204
TEXTILES	0.0306	0.0706	0.0537	0.0606
TRANSPORTATION	0.0886	0.2140	0.1600	0.1324
TRANSPORTATION EQUIP	0.0607	0.1385	0.1079	0.0886
UTILITIES	-0.0088	0.0271	0.0079	0.0065
WHOLESALE TRADE	0.0670	0.1269	0.0907	0.0979

Table 5.10
Median Absolute Percentage Errors for Forecasts by Historical Methods and IBES Forecasts
Errors Are Assessed Against Actual Dividend Growth

	HD1	HD2	HD3	HD4	HE1	HE2	HE3
AGRICULTURE AND MINING	1.452	1.491	1.294	1.634	1.651	1.373	1.826
BANKING	0.683	0.709	0.914	0.717	0.655	0.905	1.424
CHEMICALS AND DRUGS	0.681	0.657	0.826	0.801	0.748	0.713	1.075
CONSUMER GOODS	1.747	2.331	1.000	2.151	2.390	2.165	2.673
ELECTRONICS	0.760	1.118	1.000	1.345	0.871	0.836	1.108
FOOD AND BEVERAGE	0.691	0.451	0.838	0.708	0.621	0.546	1.248
FOREST PRODUCTS	1.720	1.376	1.211	1.927	1.857	1.578	1.876
MACHINERY	1.731	1.729	1.697	2.112	1.944	1.785	1.774
METALS	2.395	1.759	1.023	2.214	1.772	1.021	2.446
NON-BANK FINANCE	1.097	1.195	0.954	1.157	0.444	0.334	1.303
PETROLEUM REFINING	2.261	2.879	1.991	2.135	2.696	2.096	2.727
PUBLISHING AND PRINT	0.527	0.404	0.565	0.451	0.358	0.345	0.464
REAL ESTATE	0.738	2.279	1.303	0.735	0.994	1.000	1.731
RESTAURANTS AND SPEC TRADE	0.730	0.770	0.592	0.733	0.291	0.372	0.504
RETAIL TRADE	0.695	0.490	0.835	0.679	0.460	0.523	0.640
RUBBER, PLASTIC, AND LEATHER	1.289	0.979	0.992	1.548	0.823	0.934	1.337
SERVICE	1.825	1.284	1.000	2.542	1.060	1.041	2.537
SOCIAL SERVICES	0.706	0.718	1.000	0.847	0.409	0.512	0.813
STONE,CLAY,GLASS, AND CONCRETE	1.356	1.857	1.875	2.247	1.317	1.512	3.019
TEXTILES	1.000	1.000	1.328	0.916	0.861	1.587	2.967
TRANSPORTATION	1.347	1.389	1.638	1.375	1.396	1.379	1.379
TRANSPORTATION EQUIP	1.248	1.479	1.000	1.632	1.410	1.626	3.197
UTILITIES	0.457	0.431	0.531	0.431	0.598	0.648	2.265
WHOLESALE TRADE	0.819	1.450	1.000	1.398	1.192	0.972	1.565

Table 5.10--continued

	HE4	HB1	HB2	HB3	HB4	H1	H2
AGRICULTURE AND MINING	2.140	1.091	1.232	1.914	1.129	1.272	1.201
BANKING	0.718	0.716	0.643	0.506	0.642	0.669	0.657
CHEMICALS AND DRUGS	0.946	0.698	0.757	0.777	0.740	0.689	0.626
CONSUMER GOODS	2.885	1.019	0.991	2.121	1.042	1.337	1.250
ELECTRONICS	1.113	0.807	0.947	0.872	0.809	0.684	0.697
FOOD AND BEVERAGE	0.721	0.735	0.607	0.654	0.873	0.760	0.734
FOREST PRODUCTS	1.567	1.279	1.613	1.605	1.291	0.843	0.875
MACHINERY	2.095	1.154	1.325	2.070	1.224	1.373	1.436
METALS	1.629	1.018	1.296	1.747	1.099	1.585	1.443
NON-BANK FINANCE	0.697	0.585	0.607	0.625	0.458	0.605	0.595
PETROLEUM REFINING	2.251	1.778	2.202	1.883	1.758	1.857	1.662
PUBLISHING AND PRINT	0.331	0.727	1.054	1.012	0.562	0.684	0.669
REAL ESTATE	1.019	1.064	1.087	0.815	1.086	0.748	0.849
RESTAURANTS AND SPEC TRADE	0.284	0.591	0.543	0.469	0.586	0.722	0.581
RETAIL TRADE	0.583	0.728	0.728	0.479	0.726	0.658	0.609
RUBBER, PLASTIC, AND LEATHER	1.264	0.830	0.990	1.026	0.772	0.673	0.622
SERVICE	1.680	0.879	0.680	0.892	0.736	0.659	0.779
SOCIAL SERVICES	0.586	0.877	1.356	1.797	0.906	0.671	0.660
STONE,CLAY,GLASS, AND CONCRETE	1.652	1.150	0.831	1.136	0.906	1.237	0.895
TEXTILES	1.104	0.715	0.673	1.061	0.648	1.028	0.906
TRANSPORTATION	1.281	1.321	1.161	2.230	1.159	1.230	1.252
TRANSPORTATION EQUIP	1.698	0.950	0.981	1.191	1.023	0.863	0.895
UTILITIES	0.515	0.727	0.796	0.858	0.706	0.617	0.637
WHOLESALE TRADE	1.311	1.076	1.354	1.477	1.269	0.816	0.815

Table 5.10--continued

	LOIBES	HIIBES	MNIBES	MDIBES
AGRICULTURE AND MINING	1.439	1.692	1.574	1.577
BANKING	0.488	0.853	0.571	0.571
CHEMICALS AND DRUGS	0.699	1.789	1.354	1.256
CONSUMER GOODS	2.494	3.552	2.926	2.993
ELECTRONICS	0.714	1.707	1.149	1.009
FOOD AND BEVERAGE	0.589	1.044	0.846	0.852
FOREST PRODUCTS	1.278	3.067	2.392	2.126
MACHINERY	1.659	2.733	2.110	2.070
METALS	1.692	2.288	1.971	1.775
NON-BANK FINANCE	0.449	0.745	0.600	0.599
PETROLEUM REFINING	1.472	2.999	2.109	2.058
PUBLISHING AND PRINT	0.371	0.388	0.341	0.300
REAL ESTATE	0.858	1.153	0.907	0.866
RESTAURANTS AND SPEC TRADE	0.383	0.501	0.394	0.442
RETAIL TRADE	0.446	0.875	0.632	0.627
RUBBER, PLASTIC, AND LEATHER	1.085	1.688	1.558	1.453
SERVICE	1.322	2.378	1.979	1.745
SOCIAL SERVICES	0.444	0.777	0.568	0.524
STONE,CLAY,GLASS, AND CONCRETE	1.294	4.818	3.324	3.484
TEXTILES	0.653	0.911	0.639	0.639
TRANSPORTATION	1.693	2.265	1.859	1.823
TRANSPORTATION EQUIP	1.026	2.741	1.704	1.454
UTILITIES	0.469	0.592	0.425	0.423
WHOLESALE TRADE	1.013	1.495	1.323	1.323

accurate than the forecasts by historical methods. Out of 56 total comparisons, (4 x 14), the IBES methods produced statistically significant smaller errors than the historical methods in 42 (75%) comparisons for the Banking group, and in 43 (76.8%) comparisons for the Utility group. In two groups, Electronics and Machinery, the forecasts by historical methods produced smaller errors than the IBES forecasts in 32 (57%) and 30 (53.4%), respectively, of the 56 comparisons. There was no evidence of marginal forecast superiority in any of the other industries. Counting the significant Wilcoxon statistics along the columns indicates that the HIIBES forecasts were generally the poorest of the IBES methods, while the LOIBES forecasts indicated slightly better accuracy than the MDIBES or MNIBES forecasts.

If the comparisons are limited to the MNIBES and MDIBES forecasts as is normally done when growth estimates are utilized in cost of capital studies, the general conclusions remain unchanged. In 26 of 28 (92.8%) comparisons for the Banking group, the MNIBES and MDIBES indicated smaller forecast errors. In 22 of 28 (78.6%) comparisons for the Utilities group, the MNIBES and MDIBES indicated smaller errors than the forecasts by historical methods. And, the historical methods tended to indicate smaller errors for the Electronics and Machinery groups, with 14 (50%) and 16 (57.1%), respectively, of the 28 comparisons favoring the forecasts by methods. For the

remainder of the industry groups, no significant difference in forecast accuracy was found between the IBES and forecasts by historical methods.

As shown in Table 5.12, when errors are based on actual dividend growth, three of the twenty four industry groups indicated that the historical methods produced more accurate forecasts. Chemicals and Drugs, Consumer Goods, and Machinery each had more than fifty percent of the Wilcoxon statistics in favor of the historical methods, with 30, 31, and 29 total significant negative values out of 56 comparisons, respectively. For the remaining 21 industry groups, no significant difference between the IBES and historical method forecast errors was indicated. The Utility group did indicate somewhat better performance for the IBES based methods, although the number of favorable tests were not conclusive. It is clear, however, from an examination of Table 5.12 that the HIIBES method was significantly inferior to the historical methods.

5.5 Forecast Accuracy Within Utility Sectors

The final analysis of forecast accuracy concentrates on the Utility industry. While the companies included in the Utility group are generally more homogeneous in their growth characteristics than companies within any other of the industrial groupings, it is still of interest to determine if the security analysts' or historical methods forecasts performed better for a particular sector of the

Utility group. Further, the large number of companies contained in the original Utility group allows disaggregation among individual SIC codes while retaining a reasonable number of observations in the five resulting

Table 5.11
Summary of Wilcoxon Signed Ranks Tests by Industry
Forecasts by Historical Methods vs. IBES Forecasts
Errors Assessed Against Actual Earnings Growth

Number of Comparisons With Historical
Methods Where Statistically Significant
Differences in Errors Were Observed

	LOIBES		HIIBES		MNIBES		MDIBES		Totals	
	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
Agriculture and Mining	1	1	0	2	0	0	1	0	2	3
Banking	11	0	5	0	13	0	13	0	42	0
Chemicals and Drugs	3	1	0	8	0	4	0	4	3	17
Consumer Goods	1	0	0	8	0	4	0	3	1	15
Electronics	0	5	0	13	0	7	0	7	0	32
Food and Beverage	1	0	0	0	0	0	0	0	1	0
Forest Products	0	0	0	12	0	6	0	5	0	23
Machinery	0	3	0	11	0	8	0	8	0	30
Metals	1	3	0	5	0	3	0	3	1	14
Non-Bank Finance	7	0	0	0	3	0	4	0	14	0
Petroleum Refining	5	0	0	6	1	2	3	2	9	10
Publishing and Printing	3	0	0	0	3	0	3	0	9	0
Real Estate	1	0	1	0	1	0	1	0	4	0
Restaurants and Specialty Trade	0	0	1	0	1	0	1	0	3	0
Retail Trade	0	0	1	0	0	0	0	0	1	0
Rubber, Plastic and Leather Products	0	0	0	2	0	0	0	0	0	2
Service	3	0	0	0	1	0	2	0	6	0
Social Services	1	0	0	0	0	0	0	0	1	0
Stone, Clay, Glass and Concrete Products	0	0	0	2	0	0	0	0	0	2
Textiles	1	0	0	0	0	0	0	0	1	0
Transportation	0	0	0	3	0	0	0	0	0	3
Transportation Equipment	6	0	0	0	3	0	5	0	14	0
Utilities	9	4	13	0	11	1	10	1	43	6
Wholesale Trade	2	0	0	4	0	1	0	1	2	6
Totals	56	17	21	76	37	36	43	34		

Table 5.12
Summary of Wilcoxon Signed Ranks Tests By Industry
Forecasts by Historical Methods vs. IBES Forecasts
Errors Assessed Against Actual Dividend Growth

Number of Comparisons With Historical
Methods Where Statistically Significant
Differences in Errors Were Observed

	LOIBES		HIIBES		MNIBES		MDIBES		Totals	
	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
Agriculture and Mining	6	0	0	5	1	4	1	4	8	13
Banking	2	0	3	0	1	0	1	0	7	0
Chemicals and Drugs	2	0	0	13	0	9	1	8	3	30
Consumer Goods	0	4	0	13	0	7	0	7	0	31
Electronics	3	0	0	13	0	7	1	7	4	27
Food and Beverage	1	0	0	4	0	0	0	0	1	4
Forest Products	2	0	0	13	0	6	0	7	2	26
Machinery	1	5	0	10	0	7	0	7	1	29
Metals	0	1	0	12	0	7	0	7	0	27
Non-Bank Finance	7	0	0	6	4	0	4	0	15	6
Petroleum Refining	5	0	0	11	0	1	0	1	5	13
Publishing and Printing	3	0	0	0	3	0	1	0	7	0
Real Estate	2	0	0	0	1	0	1	0	4	0
Restaurants and Specialty Trade	4	0	0	0	3	0	3	0	10	0
Retail Trade	2	0	0	4	1	0	1	0	4	4
Rubber, Plastic and Leather Products	2	0	0	6	1	4	1	2	4	12
Service	3	0	0	7	1	1	1	1	5	9
Social Services	0	0	0	0	0	0	0	0	0	0
Stone, Clay, Glass and Concrete Products	0	1	0	8	0	7	0	8	0	24
Textiles	1	0	1	0	1	0	1	0	4	0
Transportation	0	0	0	11	0	8	0	3	0	22
Transportation Equipment	0	2	0	6	0	0	0	0	0	8
Utilities	8	0	1	7	5	0	6	0	20	7
Wholesale Trade	2	0	0	6	0	0	0	0	2	6
Totals	56	13	5	155	22	68	23	62		

sub-samples. At this stage, it is also possible to augment the IBES forecasts with an individual set of forecasts made by <u>Value Line</u> analysts in the first quarter of 1982. This not only allows the evaluation of the <u>Value Line</u> forecasts in comparison to the forecasts by

historical methods but also allows for an additional evaluation of the the IBES consensus forecasts against the Value Line forecasts.

The examination of forecast accuracy is conducted in the same manner as for the aggregate sample and the industry groupings. First, for completeness, the median actual forecast errors (AFE) assessed against earnings and dividend growth are presented in Table 5.13. The more revealing comparisons are shown in Table 5.14, where the median absolute percentage forecast error (APFE) assessed against both actual earnings and dividend growth are displayed by utility sector. Next, the results of the displayed by utility sector. Next, the results of the Wilcoxon Signed Ranks tests comparing forecasts by historical methods with IBES and Value Line forecasts are shown in Tables 5.15 through 5.19.

Based upon examination of the APFE assessed against earnings growth in the left hand panel of Table 5.14, the smallest forecast errors were exhibited by the Telephones, followed in order, by the Electric Services, Electric and Gas Combinations, Natural Gas Distribution, and Natural Gas Transmission. The within sector comparisons of historical versus IBES methods consistently indicated that the average of the IBES methods produced smaller APFE than the average historical forecast method. The Value Line forecasts were consistently more accurate in terms of APFE than the forecasts by historical methods across sectors

TABLE 5.13
Median Actual Forecast Errors

Errors Assessed Against Actual Earnings Growth

	Telephone	Electric Service	Natural Gas Trans.	Natural Gas Dist.	Electric and Gas Combination
HD1	0.0246	0.0877	-0.1141	-0.0308	0.1040
HD2	0.0179	0.0802	-0.1171	-0.0658	0.0966
HD3	0.0228	0.0715	-0.1217	-0.0778	0.0688
HD4	0.0226	0.0842	-0.1269	-0.0648	0.0961
HE1	0.0144	0.1058	-0.1526	-0.0407	0.1090
HE2	0.0161	0.0827	-0.1124	-0.0680	0.0880
HE3	-0.0759	0.0308	-0.1735	-0.1196	0.0200
HE4	0.0207	0.1113	-0.1599	-0.0487	0.1032
HB1	0.0374	0.1189	-0.0279	-0.0108	0.1060
HB2	0.0412	0.1386	-0.0668	-0.0024	0.1228
HB3	0.0163	0.1272	-0.0991	0.0033	0.1235
HB4	0.0380	0.1199	-0.0082	-0.0135	0.1023
H1	0.0118	0.0980	-0.0998	-0.0152	0.1069
H2	0.0109	0.1064	-0.0988	-0.0313	0.0989
LOIBES	0.0200	0.0987	-0.1021	-0.0402	0.0774
HIIBES	-0.0298	0.0620	-0.1371	-0.0575	0.0574
MNIBES	-0.0125	0.0865	-0.1150	-0.0522	0.0674
MDIBES	-0.0137	0.0893	-0.1121	-0.0527	0.0674
VLGE	-0.0155	0.0633	-0.0634	-0.0954	0.0529
VLGD	-0.0110	0.0627	-0.1212	-0.0970	0.0500

Errors Assessed Against Actual Dividend Growth

	Telephone	Electric Service	Natural Gas Trans.	Natural Gas Dist.	Electric and Gas Combination
HD1	-0.0293	0.0068	-0.0361	0.0142	0.0166
HD2	-0.0251	-0.0022	-0.0101	-0.0159	0.0149
HD3	-0.0203	-0.0182	-0.0248	-0.0337	-0.0020
HD4	-0.0372	0.0001	-0.0515	0.0115	0.0153
HE1	-0.0200	0.0164	-0.0407	0.0082	0.0293
HE2	-0.0192	0.0047	-0.0206	-0.0180	0.0113
HE3	-0.0857	-0.0648	-0.1084	-0.0466	-0.0516
HE4	-0.0305	0.0120	-0.0397	-0.0069	0.0206
HB1	0.0091	0.0336	0.0294	0.0466	0.0382
HB2	0.0315	0.0294	0.0208	0.0510	0.0380
HB3	0.0004	0.0336	0.0198	0.0473	0.0505
HB4	0.0141	0.0312	0.0310	0.0451	0.0314
H1	-0.0029	-0.0010	0.0176	0.0083	0.0350
H2	0.0042	0.0031	0.0174	0.0134	0.0241
LOIBES	-0.0100	0.0013	0.0057	0.0045	0.0089
HIIBES	-0.0701	-0.0378	-0.0196	-0.0202	-0.0301
MNIBES	-0.0283	-0.0151	-0.0060	-0.0043	-0.0128
MDIBES	-0.0223	-0.0157	-0.0043	-0.0063	-0.0140
VLGE	-0.0760	-0.0467	0.0241	-0.0468	-0.0140
VLGD	-0.0453	-0.0257	-0.0134	-0.0264	-0.0255

TABLE 5.14
Median Absolute Percentage Forecast Errors

Errors Assessed Against Actual Earnings Growth

	Telephone	Electric Service	Natural Gas Trans.	Natural Gas Dist.	Electric and Gas Combination
HD1	0.5356	0.7065	1.2108	0.8184	0.7508
HD2	0.5823	0.6806	1.1227	1.2427	0.7497
HD3	0.8508	0.6008	1.1991	1.1652	0.6641
HD4	0.5627	0.7207	1.2836	0.9187	0.7372
HE1	0.5926	0.8366	1.2916	0.8762	0.8519
HE2	0.9455	0.8251	1.8971	1.1478	0.7973
HE3	1.1863	0.8818	1.5952	1.8818	1.0535
HE4	0.6014	0.8201	1.3145	1.0978	0.8109
HB1	0.7659	0.9113	1.1065	0.9777	0.8981
HB2	0.9569	0.9485	0.9896	0.8744	0.9557
HB3	0.8210	0.9309	1.1737	1.0425	0.9726
HB4	0.7152	0.8975	0.9126	0.9567	0.8913
H1	0.5129	0.7661	1.1104	0.9069	0.8342
H2	0.5682	0.7750	1.0939	0.9930	0.8063
LOIBES	0.7262	0.7485	1.1048	0.8960	0.7513
HIIBES	0.8805	0.6152	1.3301	0.9197	0.5935
MNIBES	0.6026	0.6911	1.2280	0.9073	0.6917
MDIBES	0.6145	0.6920	1.2096	0.9039	0.6874
VLGE	0.3195	0.5429	0.8914	1.0841	0.5640
VLGD	0.3293	0.5353	1.3742	1.0601	0.5090

Errors Assessed Against Actual Dividend Growth

	Telephone	Electric Service	Natural Gas Trans.	Natural Gas Dist.	Electric and Gas Combination
HD1	0.6834	0.3670	0.6234	0.4524	0.4342
HD2	0.8731	0.4418	0.5173	0.5666	0.3479
HD3	0.4980	0.6565	0.9579	1.0855	0.3099
HD4	0.9579	0.3453	1.2146	0.5003	0.4029
HE1	0.6492	0.5850	0.9967	0.5214	0.5944
HE2	0.6497	0.7687	0.9629	0.4782	0.5829
HE3	2.0838	2.6647	2.3780	2.5161	2.2905
HE4	0.8962	0.5195	1.0060	0.4601	0.4688
HB1	0.8784	0.8056	0.7737	1.0011	0.7410
HB2	1.0077	0.9384	0.5109	1.1222	0.8475
HB3	1.2098	1.0555	1.1702	1.1223	1.0069
HB4	0.9464	0.7935	0.7924	0.9432	0.7552
H1	0.8829	0.7753	0.5600	0.5931	0.6315
H2	0.8334	0.7970	0.7168	0.6130	0.5675
LOIBES	0.7329	0.6381	0.4930	0.3971	0.5063
HIIBES	1.2550	0.7993	0.4943	0.4808	0.6763
MNIBES	0.8108	0.5690	0.4081	0.2550	0.4821
MDIBES	0.8308	0.5647	0.4742	0.3302	0.5336
VLGE	1.8821	1.1978	1.3034	0.8880	0.5625
VLGD	0.8985	0.6092	0.4593	0.5089	0.4788

but were mixed in comparison with the IBES consensus forecasts. Specific evaluation of the sectors indicates that the Telephone companies had an average historical methods APFE of .7270 versus an average IBES forecast APFE of .7059. If the evaluation is limited to MNIBES and MDIBES, that average drops to .6085. The Value Line forecasts, with an average APFE of .3150, were even more accurate for the Telephone sector. For the Electric Service companies the average historical methods APFE was .8073, the average IBES forecast APFE was .6827, the average of APFE of MNIBES and MDIBES was .6915, and the average Value Line APFE was .5387.

The Natural Gas Transmission and Natural Gas Distribution companies had average historical forecast APFE of 1.2358 and 1.0643. The average IBES forecast APFE for these two sectors were 1.2180 and .9067, respectively. The average of the APFE for MNIBES and MDIBES for the Natural Gas Transmission and the Natural Gas Distribution companies were 1.2188 and .9056, respectively, and the average Value Line APFE were 1.1328 and 1.0721. For the Electric and Gas Combination companies the average historical methods APFE was .8410, the average IBES forecast APFE was .6810, the average of the APFE for MNIBES and MDIBES was .6896, and the Value Line average APFE was .5365. It should be noted that the Value Line forecast of growth in dividends was almost as accurate as

the Value Line forecast of earnings growth in predicting actual earnings growth.

The second panel of Table 5.14 presents the APFE computed on the basis of actual dividend growth. Again the IBES forecasts produced smaller errors than the average forecast by historical methods. On average, the IBES forecasts produced APFE that were 31 percent smaller than the forecasts by historical methods APFE. The average APFE for the Telephone companies was .9321, .8224 for the Electric Service companies, .9415 for the Natural Gas Transmission firms, .8554 for the Natural Gas Distribution companies and .7129 for the Electric and Gas Combination companies. The average IBES forecast APFE was .9074 for the Telephones, .6427 for the Electric Service companies, .4674 for the Natural Gas Transmission firms, .3658 for the Natural Gas Distribution companies, and .5496 for the Electric and Gas Combination firms. If consideration is limited to the MNIBES and MDIBES, the average APFEs were .8208 for the Telephones, .5668 for the Electric Service companies, .4411 for the Natural Gas Transmission firms, .2929 for the Natural Gas Distribution companies, and .5079 for the Electric and Gas Combination companies. This indicates an average APFE for the MNIBES and MDIBES forecasts that was about 38 percent smaller than the forecasts by historical methods APFE. The average Value Line APFE was 1.3954 for the Telephones, .9035 for the Electric Service companies, .8814 for the Natural Gas

Transmission companies, .6854 for the Natural Gas Distribution firms, and .5206 for the Electric and Gas Combination companies. The <u>Value Line</u> forecasts indicated an average APFE that was almost equal to the average forecast by historical method APFE but about 50 percent greater than the average of IBES methods APFE.

The hypothesis that the median forecast errors of forecasts by historical methods and IBES forecasts were equivalent was tested through use of the Wilcoxon Signed Ranks tests. Tables 5.15 through 5.19 report the results of the pairwise comparisons by utility sector and for errors assessed against both actual earnings and actual dividend growth. Because this test statistic uses information about the entire distribution of forecast errors it provides a more comprehensive assessment of forecast accuracy than the limited examination of the APFE.

In general, the signs of the results shown in the left hand panels of those tables indicate that the IBES based methods were clearly superior to the historical methods in forecasting earnings growth for all utility sectors.

Statistically significant comparisons favoring the IBES forecasts occurred in 12 (of 56) tests for the Telephones, in 43 tests for the Electric Service companies, in 5 tests for the Natural Gas Transmission companies, in 4 tests for the Natural Gas Distribution

Table 5.15
Wilcoxon Signed Ranks Tests: Telephone Companies

Errors Assessed Against Actual Earnings Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	0.7338	1.7821	2.2014*	1.3628	-0.1048	1.9917*
HD2	0.7338	2.2014*	2.2014*	1.5724	0.3145	2.2014*
HD3	0.5241	0.7338	1.9917*	1.5724	0.5241	2.2014*
HD4	0.3145	0.9435	2.2014*	0.9435	0.3145	1.9917*
HE1	1.1531	2.2014*	2.2014*	2.2014*	-0.3145	2.2014*
HE2	1.1531	0.5241	0.9435	0.5241	0.3145	1.7821
HE3	1.3628	0.7338	0.9435	0.9435	1.5724	1.5724
HE4	0.7338	1.5724	2.2014*	1.7821	1.3628	2.2014*
HB1	1.3628	1.5724	0.9435	1.1531	-0.3145	0.5241
HB2	1.1531	1.5724	0.9435	0.9435	0.3145	0.9435
HB3	1.9917*	1.7821	2.0226*	2.2014*	0.1048	0.9435
HB4	0.9435	1.5724	0.9435	1.1531	-0.3145	0.3145
H1	0.6742	0.9439	0.1348	0.6742	-1.2136	-1.4832
H2	0.1048	1.3628	0.9435	0.3145	-0.9435	-0.5241
LOIBES		0.9435	0.3145	0.5241	-0.7338	-0.7338
HIIBES			0.9435	-0.1048	-0.7338	-0.9435
MNIBES				-0.4045	-0.9435	0.1048
MDIBES					-0.9435	-0.9435
VLGE						-0.5241

Errors Assessed Against Actual Dividend Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	-1.7821	0.3145	-0.1048	0.1048	-1.9917*	-0.9435
HD2	-0.5241	0.1048	0.5241	0.7338	-1.9917*	-1.5724
HD3	-1.9917*	-0.5241	0.3145	0.3145	-1.9917*	-1.3628
HD4	-0.1048	0.1048	1.5724	1.1531	-1.9917*	-1.5724
HE1	-1.7821	-0.1048	-0.9435	-0.7338	-2.2014*	-0.9435
HE2	0.1048	-0.3145	-0.9435	-0.6742	-1.9917*	-0.5241
HE3	2.2014*	0.5241	0.3145	0.5241	-0.1048	0.7338
HE4	-0.7338	-0.3145	0.1048	0.1048	-1.9917*	-0.7338
HB1	1.3628	0.3145	1.7821	1.5724	-1.7821	0.3145
HB2	1.7821	0.1048	1.7821	1.7821	-1.3628	-0.1048
HB3	1.3628	0.9435	0.9435	0.9435	-0.9435	1.3628
HB4	1.7821	0.3145	1.7821	1.7821	-1.9917*	1.5724
H1	-0.1348	0.1348	0.4045	0.6742	-0.4045	1.2136
H2	0.1048	-0.5241	0.5241	0.5241	-1.9917*	-0.7338
LOIBES		-0.1048	1.3628	1.1531	-1.9917*	-0.7338
HIIBES			1.3628	1.3628	-0.5241	0.5241
MNIBES				-0.7303	-1.5724	-0.9435
MDIBES					-1.5724	-1.1531
VLGE						2.2014*

"*" indicates significance at a=.05 level,"**" indicates significance at a=.01 level. Negative statistics indicate smaller errors for forecasting method indicated by row name, positive statistics indicate smaller errors for forecasting method indicated by column name.

Table 5.16
Wilcoxon Signed Ranks Test: Electric Service Companies

Errors Assessed Against Actual Earnings Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	0.084	2.656**	2.063*	1.915	3.882**	3.507**
HD2	-0.857	1.830	1.037	0.973	3.594**	2.632**
HD3	-1.227	1.851	1.015	0.941	2.344*	0.919
HD4	-0.550	2.306*	1.688	1.535	3.755**	3.282**
HE1	2.465*	3.978**	3.587**	3.534**	4.902**	4.257**
HE2	1.682	3.121**	2.814**	2.730**	4.153**	3.344**
HE3	1.687	3.008**	2.590**	2.522*	2.755**	1.870
HE4	2.232*	3.703**	3.682**	3.682**	4.866**	4.332**
HB1	4.804**	4.878**	5.439**	5.481**	5.385**	4.145**
HB2	5.037**	4.920**	5.439**	5.492**	5.361**	4.470**
HB3	4.074**	4.328**	5.079**	5.132**	4.709**	3.719**
HB4	4.497**	4.740**	5.333**	5.375**	5.157**	4.044**
H1	0.568	3.082**	3.394**	3.494**	3.226**	1.682
H2	0.453	3.501**	3.200**	3.177**	3.401**	1.870
LOIBES		4.270**	4.591**	4.563**	3.320**	2.006*
HIIBES			-3.851**	-4.352**	0.821	0.431
MNIBES				-0.823	1.666	0.969
MDIBES					1.666	1.006
VLGE						-1.831

Errors Assessed Against Actual Dividend Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	-2.753**	-3.851**	-3.279**	-3.465**	-2.728**	-1.129
HD2	-2.964**	-4.238**	-3.559**	-3.676**	-2.849**	-0.672
HD3	-0.805	-3.454**	-1.948	-2.054*	-1.532	0.618
HD4	-3.405**	-3.757**	-3.232**	-3.559**	-2.679**	-1.142
HE1	-1.292	-2.898**	-2.028*	-2.052*	-1.747	0.900
HE2	0.163	-1.295	-0.980	-1.050	0.564	2.285*
HE3	3.932**	2.870**	3.427**	3.440**	3.447**	4.774**
HE4	-1.493	-3.151**	-2.450*	-2.318*	-2.313*	-0.161
HB1	1.014	-1.447	-0.233	-0.163	-0.658	2.258*
HB2	1.919	-1.178	0.291	0.338	-1.048	2.271*
HB3	2.898**	-0.221	1.260	1.340	-0.879	3.494**
HB4	1.377	-1.365	-0.420	-0.420	-0.228	2.231*
H1	-0.427	-2.400*	-1.787	-1.712	-0.802	1.325
H2	0.231	-2.719**	-1.194	-1.144	-0.949	1.414
LOIBES		-2.655**	-1.398	-1.342	-0.725	1.223
HIIBES			3.205**	3.205**	1.680	3.562**
MNIBES				-0.250	0.752	2.742**
MDIBES					0.564	2.553*
VLGE						3.481**

"*" indicates significance at a=.05 level,"**" indicates significance at a=.01 level. Negative statistics indicate smaller errors for forecasting method indicated by row name, positive statistics indicate smaller errors for forecasting method indicated by column name.

Table 5.17
Wilcoxon Signed Ranks Test: Natural Gas Transmission

Errors Assessed Against Actual Earnings Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	1.572	0.104	0.733	0.943	2.201*	1.991*
HD2	0.314	-0.104	-0.943	-1.362	1.991*	1.153
HD3	1.572	-0.104	0.943	-0.104	1.991*	1.572
HD4	1.991*	0.314	0.943	1.153	2.201*	1.991*
HE1	1.782	0.524	1.782	1.782	1.991*	1.782
HE2	1.362	0.733	0.104	0.524	2.201*	1.782
HE3	2.201*	1.782	2.201*	2.201*	2.201*	2.201*
HE4	1.782	0.314	1.782	1.782	1.782	1.782
HB1	0.314	-0.524	-1.153	-1.153	1.572	0.104
HB2	0.943	-0.943	-0.314	-0.314	1.991*	1.153
HB3	-0.134	-0.943	-0.404	-0.674	1.572	1.153
HB4	0.674	-0.674	-0.134	-0.134	1.572	0.104
H1	-0.134	-1.213	-0.943	-1.213	1.752	0.404
H2	0.943	-1.213	-1.213	-1.483	1.752	-0.404
LOIBES		-1.460	-1.095	-1.460	1.991*	0.943
HIIBES			1.460	1.460	1.572	0.524
MNIBES				0.365	1.991*	0.104
MDIBES					1.991*	-0.104
VLGE						-1.782

Errors Assessed Against Actual Dividend Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	0.560	0.701	2.104*	2.024*	0.140	0.701
HD2	-1.014	-0.671	0.160	-1.182	-0.421	-0.945
HD3	1.400	0.281	0.421	0.000	-0.281	0.421
HD4	1.120	0.982	1.263	1.122	0.421	0.982
HE1	1.260	-0.140	1.824	1.683	0.421	0.561
HE2	0.700	0.982	0.701	0.561	-0.421	1.263
HE3	2.520*	2.104*	2.525*	2.525*	1.543	2.385*
HE4	1.540	0.842	1.824	1.824	0.421	0.561
HB1	1.820	1.683	1.543	1.543	-0.561	1.543
HB2	-0.700	0.000	0.701	0.701	-1.263	-0.160
HB3	1.400	1.263	1.824	1.122	-0.140	0.842
HB4	0.280	1.824	1.403	1.403	0.000	1.824
H1	-1.859	-0.331	-0.501	0.501	-1.523	-0.501
H2	0.169	0.160	0.000	-0.331	-1.353	0.671
LOIBES		0.000	0.362	1.827	-1.824	0.561
HIIBES			1.095	0.000	-0.561	0.140
MNIBES				-0.733	-1.824	0.982
MDIBES					-1.824	1.403
VLGE						1.122

"*" indicates significance at a=.05 level,"**" indicates significance at a=.01 level. Negative statistics indicate smaller errors for forecasting method indicated by row name, positive statistics indicate smaller errors for forecasting method indicated by column name.

Table 5.18
Wilcoxon Signed Ranks Test: Natural Gas Distribution

Errors Assessed Against Actual Earnings Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	1.680	1.400	1.400	1.120	0.000	-0.169
HD2	-0.059	0.177	1.836	1.125	0.140	-0.280
HD3	-0.059	0.888	1.007	0.770	0.840	0.420
HD4	1.836	1.007	2.547*	2.310*	-0.560	0.700
HE1	0.651	-0.177	-0.059	-0.059	0.560	1.120
HE2	0.059	1.125	1.243	1.007	-0.140	0.700
HE3	2.665**	2.428*	1.717	1.599	1.820	2.520*
HE4	-0.059	0.533	-0.059	-0.414	0.560	0.840
HB1	0.296	-0.651	-0.651	-0.651	-1.120	0.140
HB2	0.177	0.533	-0.414	-0.651	-1.400	-0.140
HB3	-0.177	0.651	-1.480	-1.717	-0.560	0.560
HB4	0.414	-0.651	-0.533	-0.651	-1.400	0.140
H1	-1.352	0.560	0.560	0.338	-0.845	-0.507
H2	-0.414	0.059	-0.177	-0.296	-1.521	-0.840
LOIBES		-0.674	-0.524	-0.730	-0.140	0.000
HIIBES			0.733	0.674	-0.840	0.700
MNIBES				-1.991*	-1.400	0.280
MDIBES					-1.400	0.280
VLGE						0.140

Errors Assessed Against Actual Dividend Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	0.533	0.533	1.851	1.475	-0.706	0.470
HD2	-0.156	1.035	2.201*	1.538	-0.174	-0.244
HD3	1.161	2.479*	1.851	1.600	-0.104	0.034
HD4	0.314	0.784	2.542*	2.291*	-1.083	0.174
HE1	1.013	2.201*	1.412	1.712	-0.244	-0.244
HE2	0.219	1.538	1.977*	1.600	0.174	0.034
HE3	3.295**	2.354*	2.981**	2.981**	1.782	2.411*
HE4	0.533	2.542*	2.416*	1.914	-0.594	-1.013
HB1	2.416*	0.784	0.784	0.847	1.712	2.061*
HB2	1.362	0.156	0.345	0.408	2.061*	3.109**
HB3	1.286	0.408	0.784	0.659	0.384	1.013
HB4	1.538	0.784	0.910	0.910	1.572	2.271*
H1	-0.384	0.244	0.596	0.104	-0.235	0.627
H2	0.943	0.031	0.000	-0.392	0.174	0.524
LOIBES		-0.458	1.333	0.770	-1.019	0.244
HIIBES			1.333	0.888	-1.153	-0.873
MNIBES				-1.480	-0.663	-1.490
MDIBES					-0.803	-1.502
VLGE						0.733

"*" indicates significance at a=.05 level,"**" indicates significance at a=.01 level. Negative statistics indicate smaller errors for forecasting method indicated by row name, positive statistics indicate smaller errors for forecasting method indicated by column name.

Table 5.19
Wilcoxon Signed Ranks Test: Electric and Gas Combination

Errors Assessed Against Actual Earnings Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	0.253	2.825**	2.245*	2.089*	3.507**	3.190**
HD2	-0.108	2.656**	1.642	1.545	2.813**	3.492**
HD3	-2.076*	0.893	-0.410	-0.724	1.908	1.802
HD4	0.144	2.463*	1.545	1.702	3.236**	3.417**
HE1	2.487*	3.622**	3.622**	3.550**	3.492**	3.507**
HE2	1.654	2.511*	2.282*	2.161*	2.632**	2.647**
HE3	3.182**	3.519**	3.482**	3.419**	3.299**	3.377**
HE4	1.533	3.743**	3.767**	3.574**	3.130**	3.809**
HB1	3.755**	3.199**	3.984**	4.021**	3.824**	4.050**
HB2	4.045**	4.238**	4.347**	4.371**	4.337**	4.095**
HB3	4.095**	4.745**	4.945**	4.920**	3.644**	3.424**
HB4	3.260**	2.765**	3.538**	3.598**	3.341**	3.930**
H1	3.205**	3.880**	3.833**	3.880**	2.645**	3.096**
H2	2.701**	4.256**	3.984**	4.101**	2.538*	3.462**
LOIBES		2.890**	2.105*	1.902	2.361*	2.481*
HIIBES			-2.403*	-2.560*	1.289	0.897
MNIBES				-1.439	1.501	1.636
MDIBES					1.516	1.848
VLGE						0.611

Errors Assessed Against Actual Dividend Growth

	LOIBES	HIIBES	MNIBES	MDIBES	VLGE	VLGD
HD1	-1.250	-3.019**	-1.492	-1.859	-0.175	-0.810
HD2	-1.357	-3.071**	-1.773	-2.199*	-1.211	-1.309
HD3	-1.841	-3.857**	-2.592**	-2.755**	-1.341	-1.639
HD4	-1.357	-3.531**	-1.608	-1.979*	-1.024	-1.602
HE1	1.209	-2.156*	0.211	0.105	0.065	1.807
HE2	0.823	-1.787	0.804	0.757	0.089	1.835
HE3	4.591**	3.468**	4.214**	4.253**	4.330**	4.796
HE4	-0.241	-2.458*	-0.543	-0.790	-0.545	0.196
HB1	2.567*	0.551	1.801	1.801	0.768	2.123*
HB2	2.863**	-0.177	1.701	1.845	1.718	3.199
HB3	4.800**	2.051*	4.194**	4.156**	3.397**	4.456
HB4	2.217*	0.268	1.461	1.428	0.014	1.224
H1	1.438	-1.061	0.363	0.438	1.456	3.083**
H2	1.863	-2.021*	0.078	-0.063	-0.344	2.008*
LOIBES		-2.728**	-0.568	-0.920	0.168	0.494
HIIBES			3.470**	3.184**	2.174*	3.065**
MNIBES				-1.000	0.909	1.509
MDIBES					0.771	1.588
VLGE						1.922

"*" indicates significance at a=.05 level, "**" indicates significance at a=.01 level. Negative statistics indicate smaller errors for forecasting method indicated by row name, positive statistics indicate smaller errors for forecasting method indicated by column name.

companies, and in 43 tests for the Electric and Gas Combination companies. Statistically significant tests favoring the forecasts by historical methods occurred in none of the tests for the Telephones, Electric Service, Natural Gas Transmission, or Natural Gas Distribution companies, and in only one test for the Electric and Gas Combination companies. The signs of the reported results indicate that the Value Line forecasts were also superior to the forecasts by historical methods in terms of producing smaller forecast errors, but roughly equivalent to the IBES forecasts. Statistically significant tests statistics favoring value line forecasts over the IBES methods occurred in 7 of 20 total pairwise comparisons across the five utility sectors.

The signs of the results shown in the second panels of Tables 5.15 through 5.19 indicate the IBES methods were superior to the forecasts by historical methods in terms of forecast accuracy for actual dividend growth for the Telephones, Natural Gas Transmission, and Natural Gas Distribution companies, but inferior in forecast accuracy for the Electric Service companies. These data also indicate that the IBES methods were roughly equal in forecast accuracy with the historical methods in forecasting dividend growth for the Electric and Gas Combination companies. Statistically significant statistics favoring the IBES forecasts over the forecasts by historical methods occurred in 1 test for the

Telephones, in 6 tests for the Electric Service companies, in 6 tests for the Natural Gas Transmission companies, in 13 tests for the Natural Gas Distribution companies, and in 11 tests for the Electric and Gas Combination companies. Significant statistics favoring the forecasts by historical methods were observed in 21 tests for the Electric Service companies and 11 tests for the Electric and Gas Combination companies, but in none of the tests for the other utility sectors. The signs of the statistics indicate that the Value Line forecasts were about equivalent to both the IBES forecasts and the forecasts by historical methods in terms of consistency in producing the smallest forecast errors about dividend growth. If consideration is limited specifically to the Value Line dividend growth forecast, the results indicate that that Value Line method was superior in terms of forecast accuracy to the historical methods but again about equal to the IBES methods.

5.6 Decomposition of Forecast Errors and Error Diagnosis

In order to probe more deeply into the nature of the forecasting accuracy of the various methods it is necessary to decompose the gross forecast errors into their constituent sources of error. There are numerous decomposition techniques suggested by Theil (1962), Crichfield, Dyckman, and Lakonishok (1978), Elton, Gruber, and Gultekin (1981), and Cragg and Malkiel (1982). This

study employs several decomposition methods in order to provide different perspectives on the nature of the errors.

The following notation will be used to explain the various decomposition techniques. The display of subscripts representing the forecasting method has been suppressed.

MSFE	Mean Squared Forecast Error for forecast method i
N	Number of companies in sample with observations for forecast method i.
N_k	Number of companies in industry k.
$\underline{\underline{F}}$	The mean forecast value of method i across all companies.
$\underline{F}_k$	The mean forecast value of method i across all companies in industry k.
F_j	The forecast value of method i for company j.
$\underline{\underline{A}}$	The mean actual growth rate outcome (earnings or dividends depending on the respective discussion) across all companies.
$\underline{A}_k$	The mean actual growth rate outcome (earnings or dividends depending on the respective discussion) across all companies in industry k.
A_j	The actual growth rate outcome (earnings or dividends depending on the respective discussion) for company i.
s_F	The cross-section standard deviation of method i forecasts across all companies.
s_A	The cross-section standard deviation of actual growth rate outcomes across all companies.
$s_{F,k}$	The cross-section standard deviation of method i forecasts across all companies in industry k.

$s_{A,k}$ The cross-section standard deviation of actual growth rate outcomes across all companies in industry k.

r The correlation coefficient of method i forecasts with actual growth rate outcomes across all companies.

r_k The correlation coefficient of method i forecasts with actual growth rate outcomes across all companies in industry k.

Following Cragg and Malkiel (1982) and Elton, Gruber, and Gultekin (1981), the first decomposition is accomplished by examining the extent to which forecast errors were related to error in forecasting the average growth rate of sample firms, to error in forecasting the average growth rate of particular industries, and to error in forecasting the growth rate of companies within industries. The MSFE is decomposed into three parts. The first part (SOURCE 1) is attributable to the average forecast of all companies not being equal to the average actual outcome. The second part (SOURCE 2) reflects differences among the average industry forecasts not being equal to the corresponding differences in the average industry actual outcomes. The third part (SOURCE 3) comes from the inequality of the differences of individual company forecasts from industry average forecasts and the differences in company versus industry actual growth outcomes. Algebraically,

$$MSFE = (\underline{F} - \underline{A})^2 + \frac{1}{N} \sum N_k[(\underline{F}_k - \underline{F}) - (\underline{A}_k - \underline{A})]^2$$

$$+ \frac{1}{N} \sum [(F_j - \underline{F}_k) - (A_j - \underline{A}_k)]^2 .$$

SOURCE 1, 2, and 3 are represented, respectively, by the first, second, and third terms on the right hand side of the equation. Each term on the right hand side of the equation is divided by the MSFE to determine the percentage of the error that is attributable to that source of forecasting inaccuracy. The MSFE and the proportionate source contributions to the forecast error are shown in Table 5.20 for errors based on earnings per share growth and in Table 5.21 for errors based on dividend per share growth.

As shown in Table 5.20 failure to forecast industry means (SOURCE 2) accounted for a small percentage, on average about 11.6 percent, of the total error when measured against actual earnings per share growth. The main sources of error were company specific, on average about 84.7 percent, as captured through SOURCE 3 by the differences of individual company and industry average values. The results are somewhat dissimilar to those of Cragg and Malkiel (1982) in terms of the magnitude of the proportionate sources of the error. On average, they found that SOURCE 3 error contributed about 50 percent of the total error, SOURCE 2 contributed about 19 percent,

Table 5.20
Decomposition of Forecast Error By Level of Aggregation
Errors Assessed Against Actual Earnings Per Share Growth

Forecast Method	MSFE	SOURCE 1	SOURCE 2	SOURCE 3
HD1	0.04978	2.1699%	15.0575%	82.7725%
HD2	0.04912	2.9597	12.6578	84.3825
HD3	0.05427	1.5522	9.6080	88.8398
HD4	0.05171	5.2761	16.9245	77.7994
HE1	0.05960	1.3051	11.2710	87.4240
HE2	0.06889	0.2698	8.5687	91.1615
HE3	0.06632	0.0346	7.2187	92.7467
HE4	0.06082	4.2458	13.0547	82.6995
HB1	0.04741	2.8641	9.8086	87.3273
HB2	0.04973	4.1679	9.2374	86.5947
HB3	0.07036	3.6797	6.6997	89.6206
HB4	0.04569	1.5109	10.7318	87.7573
H1	0.04414	0.1927	13.3991	86.4082
H2	0.04787	0.0606	11.9271	88.0123
LOIBES	0.04994	3.1398	13.2436	83.6166
HIIBES	0.08473	14.7123	12.6280	72.6597
MNIBES	0.05388	9.0548	14.1595	76.7857
MDIBES	0.05360	8.1825	13.9053	77.9121

Table 5.21
Decomposition of Forecast Error By Level of Aggregation
Errors Assessed Against Actual Dividends Per Share Growth

Forecast Method	MSFE	SOURCE 1	SOURCE 2	SOURCE 3
HD1	0.01642	12.1210%	46.4667%	41.4123%
HD2	0.02574	19.0482	28.1036	52.8482
HD3	0.02669	13.2608	23.0112	63.7280
HD4	0.02572	26.5219	37.6119	35.8662
HE1	0.02421	13.5810	31.3296	55.0894
HE2	0.02369	6.3419	27.5829	66.0752
HE3	0.04034	0.6318	12.1766	87.1916
HE4	0.02395	24.4472	35.9035	39.6493
HB1	0.01439	1.7271	35.4033	62.8696
HB2	0.01753	4.7607	27.7702	67.4692
HB3	0.04000	4.1674	12.0359	83.7967
HB4	0.01358	0.3406	38.8768	60.7826
H1	0.01651	1.7916	36.2117	61.9967
H2	0.01643	1.9953	35.7183	62.2863
LOIBES	0.01645	22.7557	43.0427	34.2015
HIIBES	0.05444	32.8283	20.5445	46.6272
MNIBES	0.02253	37.3838	35.9937	26.6224
MDIBES	0.02126	36.4079	37.2797	26.3124

and SOURCE1 accounted for 31 percent of the total error. However, their sample companies were limited to large, mature firms with widely held securities. Thus, their finding of a smaller percentage contribution attributable to company specific effects may be primarily due to the relative ease of making accurate forecasts for their better known and more closely followed firms.

When the forecast error is measured against actual dividend per share growth, as shown in Table 5.21, the proportionate contribution to error is substantially different. On average, about 54 percent of the forecast error was attributable to the SOURCE 3, company specific effects, while 15 and 31 percent of the error was attributable to economy-wide and industry effects, respectively. These results appear to be driven by the observation that individual company dividend policies and dividend flows tend to be more stable and less influenced by transient events that are earnings, thus making company-specific dividend growth more predictable than earnings growth.

The next form of decomposition is attributable to Crichfield, Dyckman, and Lakonishok (1978) and Elton, Gruber, and Gultekin (1981). The decomposition that was presented above can be used to aid forecasters by determining at what level of aggregation, forecast mistakes are being made. The type of decomposition presented next searches for a pattern of systematic

errors. Again, the MSFE is decomposed into three sources of error. The first is termed BIAS. It represents the tendency of the average method i forecast to either overestimate or underestimate the true average actual outcome. The second source is termed EFFICIENCY . This measures the tendency for forecasts to be underestimated when actual outcomes turned out to be high, and the tendency for forecasts to be overestimated when actual outcomes turned out to be low. The final source is termed RANDOM. It measures the forecast error not related to joint distribution of the forecast and the actual growth rate outcome. Algebraically, the decomposition is as follows,

$$MSFE = (\underline{\underline{F}} - \underline{\underline{A}})^2 + (s_F - rs_A)^2 + (1 - r^2)s_A{}^2 \quad .$$

This decomposition follows from postulating a model of the forecast decision process. Assuming the forecast can be regarded as consisting of a systematic part and nonsystematic part of the actual outcome, then it would be reasonable to concentrate attention on making accurate forecasts of the systematic portion. If the forecast method is able to predict the systematic portion exactly, the actual growth outcome, A_j, can be viewed as consisting of the forecast, F_j, and a random disturbance, e_j, term which would be independent of the forecast and have a zero expectation. Thus, this decomposition assumes Aj can be written as a linear combination of F_j and e_j, or as it

would be expressed in a regression model,

$$A_j = a + B F_j + e_j \ .$$

If the forecast had predicted the systematic portion exactly, then a regression would indicate a = 0 and B = 1. Note that since the disturbance term has zero mean, the average values of F and A should be identical, thus the first term on the right hand side of the decomposition equation, $(\underline{\underline{F}} - \underline{\underline{A}})^2$, should tend toward zero as the forecasts do a better job of evaluating the systematic proportion. And because B = Covariance$(F_j, A_j)/s^2{}_F$, which in turn can be shown to be equivalent to

$$B = \frac{rs_A}{s_F}$$

and if B = 1, then $rs_A = s_F$. This implies that as the forecast comes closer to predicting the systematic portion of the actual outcome, then the second term on the right hand side of the decomposition equation, $(s_F - rs_A)^2$, should also tend to vanish.

Thus, the amount of systematic linear bias in the forecasts can be determined by examining the relative proportions of the decomposition terms. If the forecasts do not tend to contain such linear biases, the first and second components, BIAS and EFFICIENCY, should contribute relatively small proportions to the total error, and the third term, RANDOM, should be relatively large.

This results of this type of decomposition are first examined at an aggregate sample level in Tables 5.22 and

Table 5.22
Decomposition by Bias, Efficiency, and Random Error
Errors Assessed Against Actual Earnings Growth

	MSFE	BIAS	EFFICIENCY	RANDOM
HD1	0.04978	2.1699%	31.2487%	66.5814%
HD2	0.04912	2.9597	20.5447	76.4956
HD3	0.05427	1.5522	29.4587	68.9890
HD4	0.05171	5.2761	28.8401	65.8838
HE1	0.05960	1.3051	43.1139	55.5810
HE2	0.06889	0.2698	51.9099	47.8203
HE3	0.06632	0.0346	53.9173	46.0481
HE4	0.06082	4.2458	37.3212	58.4330
HB1	0.04741	2.8641	6.0378	91.0980
HB2	0.04973	4.1679	9.0509	86.7812
HB3	0.07036	3.6797	35.0020	61.3184
HB4	0.04569	1.5109	4.4795	94.0096
H1	0.04414	0.1927	34.6095	65.1978
H2	0.04787	0.0606	35.9689	63.9705
LOIBES	0.04994	3.1398	10.5093	86.3509
HIIBES	0.08473	14.7123	34.3165	50.9712
MNIBES	0.05388	9.0548	10.7880	80.1572
MDIBES	0.05360	8.1825	11.5145	80.3030

Table 5.23
Decomposition by Bias, Efficiency, and Random Error
Errors Assessed Against Actual Dividend Growth

	MSFE	BIAS	EFFICIENCY	RANDOM
HD1	0.01643	12.1210%	44.4978%	43.3813%
HD2	0.02574	19.0482	34.2389	46.7129
HD3	0.02669	13.2608	45.5935	41.1457
HD4	0.02572	26.5219	31.8866	41.5914
HE1	0.02421	13.5810	35.8178	50.6012
HE2	0.02369	6.3419	44.1214	49.5367
HE3	0.04034	0.6318	73.3151	26.0531
HE4	0.02396	24.4472	27.0410	48.5117
HB1	0.01439	1.7271	13.5994	84.6735
HB2	0.01753	4.7607	25.6397	69.5997
HB3	0.04000	4.1674	66.6381	29.1946
HB4	0.01358	0.3406	15.0155	84.6439
H1	0.01651	1.7916	26.7226	71.4858
H2	0.01644	1.9953	25.4231	72.5815
LOIBES	0.01645	22.7557	6.0994	71.1449
HIIBES	0.05444	32.8283	44.6858	22.4860
MNIBES	0.02253	37.3838	9.4564	53.1598
MDIBES	0.02126	36.4079	7.3868	56.2053

5.23 under errors computed for both earnings and dividends respectively.

Examination of Table 5.22 indicates that the IBES based forecast methods exhibited, on average, less linear bias than the historically based forecasts. This is as expected, given that the historically based methods are naive extrapolations and would be generally inefficient in their use of information. For example, when errors are measured against actual earnings growth, the fourteen historically based methods indicated an average contribution to MSFE due to inefficiency of 30.11 percent while the IBES based methods indicated only 16.78 percent of the error was due to inefficiency. At the same time, the historically based methods averaged a 2.16 percent error contribution due to bias, while the IBES methods averaged a 8.77 percent contribution due to bias. When errors are assessed against actual dividend growth, the contribution to total error from inefficiency averaged 16.91 percent for the IBES forecasts, and 36.40 percent for the historically based forecasts.

These conclusions are confirmed by examining Table 5.24. In that table the computed t-statistics derived from regressing the forecasted growth on the actual growth outcome are presented. Under the model of linear forecasting bias and inefficiency postulated above, an unbiased and efficient forecast should result in an estimated intercept term, a, equal to zero and an

estimated slope coefficient, B, equal to one. It is clear from these results, however, that for the aggregate sample, the null hypotheses are rejected at normal confidence levels for all of the forecast methods. However, the relative size of the t-statistics indicates that the MNIBES and MDIBES exhibit less linear bias and inefficiency than the forecasts by historical methods on average, especially for the prediction of actual dividend growth.[7]

5.7 Industry Level Error Decomposition

Appendices 6 and 7 present the results of this same type of error decomposition when the sample companies are grouped by industrial category. In that analysis, the mean square forecast error is examined at the industry level, thus the decomposition focuses on the bias, inefficiency, and random components relative to the average industry forecast and average industry actual outcome. Disaggregation and examination of the industry MSFE is perhaps more appropriate than attempting to ascertain forecast accuracy for the entire sample population. That is, as was shown earlier, certain forecast methods produce better results for some industry sectors than other methods and the the forecasting

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[7]These results are based on regressions that use only observations for which there were no missing values for any forecast method.

TABLE 5.24
Evaluation of Linear Bias and Inefficiency

	Earnings Growth		Dividend Growth	
	t-Statistic for			
	H_0:a=0	H_0:B=1	H_0:a=0	H_0:B=1
HD1	5.637	-9.786	4.603	-13.221
HD2	5.213	-8.839	3.189	-10.832
HD3	4.779	-9.564	3.594	-13.980
HD4	5.495	-10.040	4.717	-14.382
HE1	7.879	-12.582	4.680	-13.221
HE2	5.697	-10.335	4.135	-13.284
HE3	4.957	-17.247	9.954	-39.208
HE4	6.800	-11.277	3.649	-12.526
HB1	4.131	-3.930	8.709	-9.402
HB2	4.982	-6.179	10.568	-14.801
HB3	5.940	-15.793	11.989	-34.032
HB4	3.848	-4.150	8.562	-10.750
H1	12.502	-14.641	8.113	-10.587
H2	11.048	-13.256	7.014	-9.589
LOIBES	4.985	-7.058	1.779	-6.143
HIIBES	6.150	-17.824	7.294	-32.611
MNIBES	6.348	-9.888	3.109	-10.543
MDIBES	6.186	-9.354	2.453	-9.123

inefficiency and bias indicated at the gross level may not be applicable to all industry sectors.

Using the above notation, the decomposition is expressed algebraically as follows, where the subscript k refers to a particular industry,

$$MSFE_k = (\underline{F}_k - \underline{A}_k)^2 + (s_{F,k} - r_k s_{A,k})^2 + (1 - r_k^2) s_{A,k}^2 \ .$$

To aid in understanding these results, Figures 5.3 and 5.4 present a summary of the computations shown in Appendices 6 and 7.[8] Figure 5.3 presents a comparison of the average sources of error for the fourteen historically based methods and the four IBES forecasts by

[8]Several industry groups are not displayed in the figures due to nonmeaningful results that were primarily related to a small number of observations within an industrial group being dominated by extreme values of MSFE. The appendices contain all computed results.

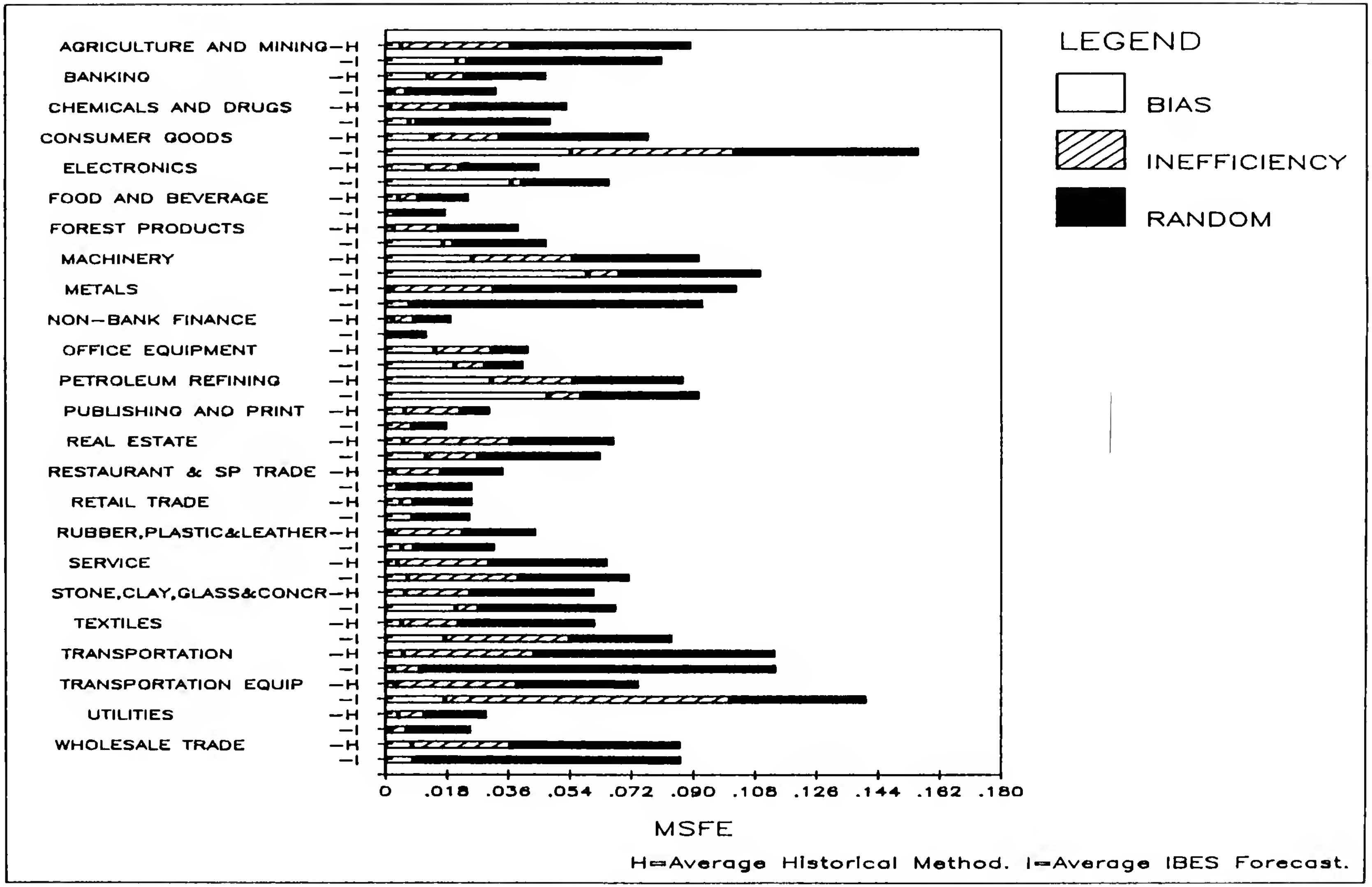

Figure 5.3
Decomposition of Forecast Errors
Errors Assessed Against Actual Earnings Growth

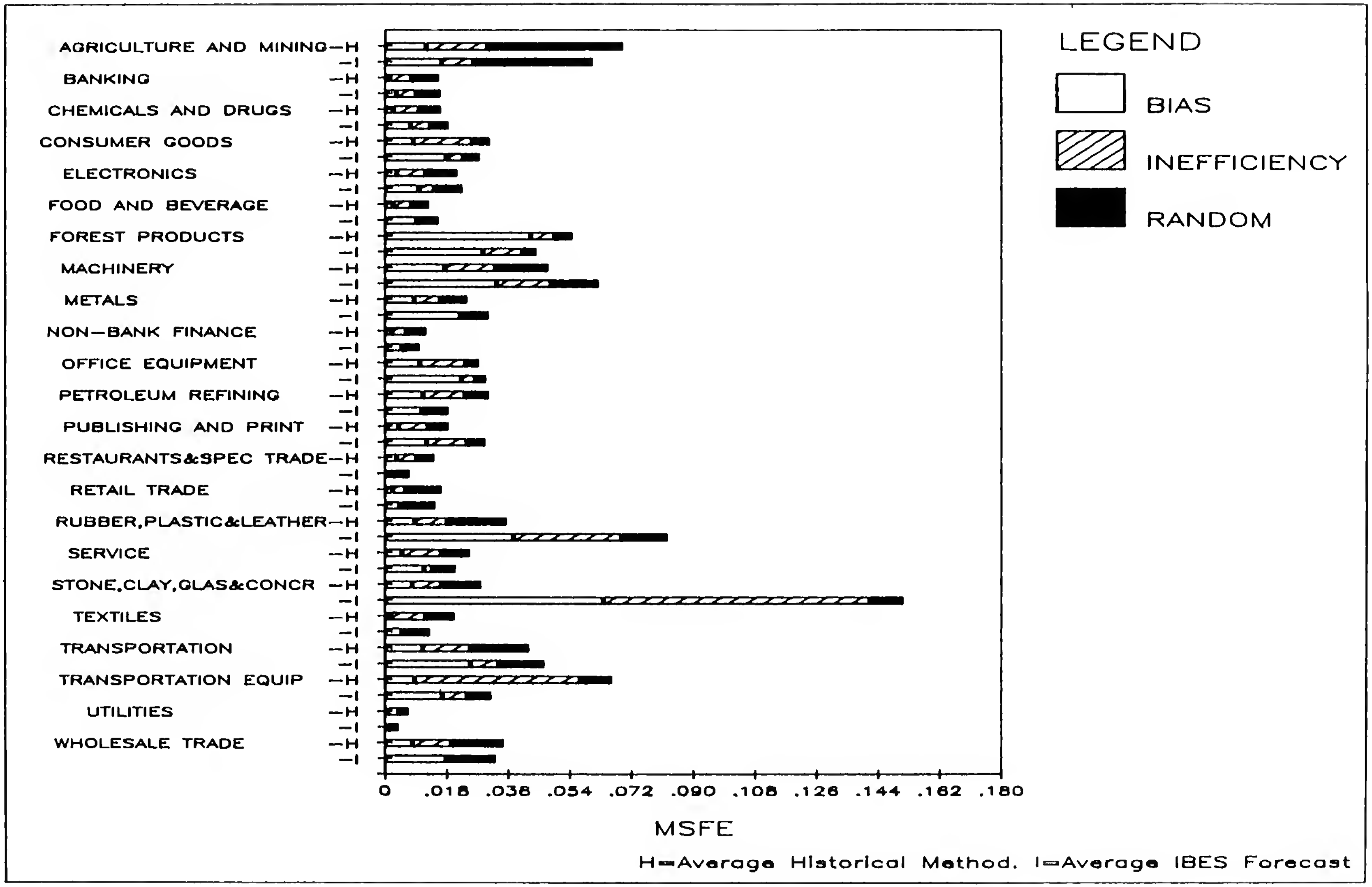

Figure 5.4
Decomposition of Forecast Errors
Errors Assessed Against Actual Dividend Growth

industrial category when the errors were measured against actual earnings growth. The total length of the respective bar indicates the value of the average MSFE, while the segments comprising each bar indicate the average amounts of the respective sources of that error. The sum of the bar segments labeled BIAS and INEFFICIENCY represents the total amount of average linear bias for either the historical forecasts. Figure 5.4 presents equivalent results when errors were measured against actual dividend growth.

A simple means test using the pooled variance of the historical and IBES methods was employed to evaluate the following hypothesis:

> H0: The proportion of MSFE attributable to linear biases within specific industrial categories is equivalent for both the historical and IBES methods,

$$\% \text{ Linear Bias}_{\text{HISTORICAL}} = \% \text{ Linear Bias}_{\text{IBES}}$$

The resulting t-statistics are shown below in Table 5.25. A negatively signed statistic indicates that the proportion of bias related error for the historical methods was smaller on average than the portion of the linear bias related error for the average IBES method and vice versa for a positively signed statistic.

Column (1) of Table 5.25 displays the t-statistics for differences in average bias proportions when the MSFE were based on earnings growth. The comparisons in Column (1) are between the fourteen forecasts by historical

methods and the four IBES forecasts. Those statistics indicate that in 15 of the 24 industry groups, the forecast error attributable to linear bias was smaller for the IBES forecasts than for the historical forecasts. Statistically significant differences favoring the IBES forecasts occurred in the Banking, Non-Bank Finance, and Wholesale Trade categories. Statistically significant differences favoring the historical forecasts occurred in the Textile group.

Column (2) displays the t-statistics for differences in average bias proportions when the MSFE were based on dividend growth. The comparisons in Column (2) are between the fourteen forecasts by historical methods and the four IBES forecasts. Twenty-two of the twenty-four industries have negatively signed statistics, thus indicating that the forecasts by historical methods for those industries had smaller contributions to total error attributable to linear biases. None of the statistics, however, are significant at normal confidence levels, therefore the null hypothesis of equivalent linear bias could not be rejected for any of these industrial groupings.

Column (3) of Table 5.25 displays the t-statistics for differences in average bias proportions when the MSFE were based on earnings growth. The comparisons in Column (3) are between the fourteen forecasts by historical methods and the MNIBES and MDIBES forecasts only. Those

statistics indicate that in 16 of the 25 industry groups, the forecast error attributable to linear bias was smaller for the IBES forecasts than for the historical forecasts. As in Column (1), statistically significant differences favoring the IBES forecasts occurred in the Banking, Non-Bank Finance, and Wholesale Trade categories. Statistically significant differences favoring the historical forecasts occurred in the Textile group. It should be noted that the positive difference in statistics between Column (1) and Column (3) is reflective of the smaller amount of linear bias produced by the MNIBES and MDIBES and compared to the LOIBES and HIIBES forecasts.

Finally, Column (4) displays the t-statistics for differences in average bias proportions when the MSFE were based on dividend growth. The comparisons in Column (2) are between the fourteen forecasts by historical methods and the MNIBES and MDIBES forecasts only. Twenty-three of the twenty-four industries have negatively signed statistics, thus indicating that the forecasts by historical methods for those industries had smaller contributions to total error attributable to linear biases. Nine of the industry-group statistics are significant at normal confidence levels. Thus, the MNIBES and MDIBES forecasts contained relatively more systematic biases as estimates for dividend growth than the average forecast by historical methods for the Banking, Food and Beverage, Non-Bank Finance, Retail Trade, Stone, Glass,

Clay, and Concrete Products, Transportation, and Wholesale Trade industries. No significant differences from the contributions of systematic linear biases to total error were observed for the other industry groupings.

5.8 Error Decomposition by Utility Sector

The final error decomposition focuses on the Utility group companies. The decomposition technique is limited to the examination of linear bias in the forecasting methods. Again, applying the methods of Crichfield, Dyckman, and Lanishok, the MSFE of the utility sectors are disaggregated by the source of that error, where the term BIAS refers to the ability to successfully predict the sector mean growth rate, the term EFFICIENCY is the tendency to over (or under) forecast when actual outcomes are high (or low), and the term RANDOM refers to the idiosyncratic nature of the forecast error. A forecast method that exhibits low linear bias will indicate small contributions to the total error from the sum of BIAS and EFFICIENCY.

Tables 5.26 through 5.30 present the MSFE and constituent sources of that error for each of the fourteen forecasts by historical methods, the four IBES forecasts, and the two Value Line forecasts. As shown in either the tables, for the Telephone companies, when errors are assessed against earnings growth, the Value Line dividend growth forecast, the MDIBES, and the MNIBES indicate the

smallest amount of linear bias. When errors were measured against dividend growth, the HB1 method indicated the smallest amount of linear bias. For the Electric Service companies, using actual earnings growth, all of the

Table 5.25
Comparison of Sources of Error
Forecasts by Historical Methods vs. IBES Forecasts
Test for Differences in Linear Bias Contribution to MSFE

t-Statistics

	All IBES		MNIBES & MDIBES	
	(1)	(2)	(3)	(4)
AGRICULTURE AND MINING	0.742	-0.579	0.822	-1.415
BANKING	3.415	-0.961	3.698	-2.267
CHEMICALS AND DRUGS	1.036	-1.024	1.172	-1.907
CONSUMER GOODS	-0.723	-0.699	-0.423	-0.511
ELECTRONICS	-1.022	-0.962	-1.013	-1.508
FOOD AND BEVERAGE	1.391	-0.738	1.514	-1.981
FOREST PRODUCTS	-0.070	-0.734	0.134	-0.840
MACHINERY	-0.357	-0.446	-0.356	-0.589
METALS	1.248	-1.085	1.314	-1.304
NON-BANK FINANCE	3.053	-0.855	3.353	-2.189
OFFICE EQUIPMENT	-0.560	-0.734	-0.851	-1.232
PETROLEUM REFINING	-0.185	1.408	-0.242	2.703
PUBLISHING AND PRINT	1.264	-0.240	1.447	-1.762
REAL ESTATE	0.280	0.051	0.292	-0.955
RESTAURANTS AND SPEC TRADE	1.536	0.069	1.805	-1.537
RETAIL TRADE	-0.368	-0.756	-0.361	-2.275
RUBBER, PLASTIC, AND LEATHER	0.911	-1.288	1.365	-2.240
SERVICE	-0.664	-0.924	-0.648	-1.871
STONE,CLAY,GLASS, AND CONCRETE	0.110	-1.565	0.539	-2.756
TEXTILES	-2.003	-0.578	-2.079	-1.403
TRANSPORTATION	1.232	-1.454	1.319	-2.325
TRANSPORTATION EQUIP	0.551	-0.939	1.221	-1.546
UTILITIES	1.347	-0.013	1.473	-0.827
WHOLESALE TRADE	2.023	-1.362	2.028	-2.439

forecast methods indicated substantial linear bias. Assessing Electric Service companies' errors against actual dividend growth indicates much the same pattern of bias, although the HD1 method was a less biased predictor of dividend growth than of earnings growth. And in

general, the forecast methods for the Natural Gas Transmission companies, the Natural Gas Distribution companies, and the Electric and Gas Combination companies all exhibit substantial linear bias.

In addition to the examination of the mean values and the graphical presentation, ordinary least squares estimates of the intercept and slope parameters of a regression of the forecast on the actual growth rates were employed to test statistically for the presence of linear bias. Recall from the discussion in Section 5.5, the hypotheses about the absence of linear bias are indicated by an intercept term of zero and a slope coefficient of one. Tables 5.31 through 5.35 present the t-statistics for the tests of these relevant hypotheses by utility sector.

As shown in Table 5.31, for the Telephone sector, when errors are assessed against earnings growth, the null hypotheses of the absence of linear biases are rejected at normal confidence levels for HD3, HE3, and HB2 of the historical methods, and both VLGE and VLGD of the Value Line methods. The null hypotheses could not be rejected for the IBES forecasts. When errors were assessed against actual dividend growth, the null hypotheses were rejected for the Value Line forecasts and historical methods HE2 and HB1. The null hypotheses that the forecast method did not exhibit systematic linear bias could not be rejected for the IBES methods.

Within the Electric Service companies, as shown in Table 5.32, the absence of linear bias was rejected in all of forecast methods, when errors were assessed against earnings growth. When the actual dividend growth rate was used as the standard, the null hypotheses were rejected for all 14 forecasts by historical methods and for both VLGE and VLGD. The presence of linear bias was not statistically significant in any of the four IBES forecasts.

Table 5.33 presents similar statistics for the Natural Gas Transmission companies. When the regressions were run using actual earnings growth, the t-statistics indicate that historical methods HE3, HB3, H1, and H2, and Value Line methods VLGE and VLGD all exhibited statistically significant linear bias. The dividend growth results indicate rejection of the null hypotheses for all of the historical methods as well as the Value Line methods, but not for any of IBES methods.

In Table 5.34, for the Natural Gas Distribution companies, the null hypotheses were rejected for all of the historical methods and for the Value Line methods when the regressions were based on actual earnings growth. The null hypotheses could not be rejected for any of the tests on the IBES forecasts. Almost the opposite results were found when the regressions were computed with the dividend growth rates. In that instance, statistically significant linear biases were detected for each of the

Table 5.26
Decomposition of Forecast Error: Telephones

	Errors Assessed Against Earnings Growth				Errors Assessed Against Dividend Growth			
	MSFE	BIAS	EFFICIENCY	RANDOM	MSFE	BIAS	EFFICIENCY	RANDOM
HD1	0.015559	0.001708	0.105369	0.892922	0.012823	0.237595	0.030602	0.731803
HD2	0.014807	0.001938	0.026026	0.972035	0.011422	0.268685	0.005141	0.726175
HD3	0.019295	0.000004	0.422058	0.577938	0.013633	0.185751	0.132043	0.682206
HD4	0.015935	0.011834	0.103647	0.884519	0.014005	0.290401	0.039210	0.670389
HE1	0.015742	0.000404	0.178276	0.821321	0.012591	0.219428	0.040157	0.740415
HE2	0.018612	0.008713	0.282589	0.708698	0.011362	0.122491	0.061581	0.815927
HE3	0.049483	0.156255	0.552235	0.291510	0.049290	0.386207	0.430158	0.183636
HE4	0.015954	0.005213	0.133250	0.861537	0.013494	0.259371	0.046725	0.693905
HB1	0.013509	0.090744	0.031805	0.877451	0.009564	0.023613	0.020893	0.955495
HB2	0.012469	0.152731	0.056702	0.790568	0.008037	0.005098	0.001529	0.993373
HB3	0.011230	0.079391	0.011600	0.909009	0.009146	0.044526	0.125805	0.829669
HB4	0.013749	0.089305	0.015174	0.895521	0.009826	0.022898	0.037182	0.939921
H1	0.005673	0.227173	0.005603	0.767224	0.002853	0.086279	0.825217	0.088504
H2	0.005547	0.228403	0.033267	0.738330	0.002847	0.091176	0.828143	0.080681
LOIBES	0.013488	0.015789	0.003429	0.980782	0.011562	0.108671	0.079814	0.811514
HIIBES	0.014778	0.113235	0.031803	0.854962	0.019964	0.414319	0.125196	0.460486
MNIBES	0.012666	0.006324	0.001882	0.991794	0.013783	0.252472	0.070064	0.677463
MDIBES	0.012836	0.002032	0.000450	0.997518	0.013593	0.223739	0.086433	0.689829
VLGE	0.003796	0.112071	0.000003	0.887926	0.005618	0.888811	0.021493	0.089697
VLGD	0.003614	0.000129	0.000583	0.999288	0.003998	0.609320	0.042967	0.347713

Table 5.27
Decomposition of Forecast Error: Electric Service Companies

	Errors Assessed Against Earnings Growth				Errors Assessed Against Dividend Growth			
	MSFE	BIAS	EFFICIENCY	RANDOM	MSFE	BIAS	EFFICIENCY	RANDOM
HD1	0.015910	0.579994	0.086619	0.333387	0.002120	0.006822	0.040936	0.952241
HD2	0.014930	0.565972	0.071294	0.362734	0.002706	0.027558	0.188668	0.783773
HD3	0.013871	0.483278	0.128694	0.388029	0.002554	0.155372	0.092515	0.752113
HD4	0.021671	0.470592	0.147128	0.382280	0.002230	0.032851	0.067608	0.899541
HE1	0.030441	0.513156	0.287801	0.199042	0.002122	0.080508	0.031205	0.888286
HE2	0.036528	0.358080	0.480323	0.161597	0.004787	0.001080	0.528831	0.470089
HE3	0.045646	0.072756	0.752147	0.175096	0.033566	0.082763	0.845371	0.071866
HE4	0.030384	0.517123	0.258996	0.223881	0.001957	0.087961	0.018307	0.893732
HB1	0.026255	0.655299	0.007666	0.337034	0.003784	0.147454	0.246692	0.605854
HB2	0.028350	0.683475	0.012417	0.304108	0.004963	0.195036	0.340871	0.464094
HB3	0.030384	0.623851	0.098858	0.277291	0.006947	0.089711	0.576429	0.333860
HB4	0.026866	0.640071	0.027035	0.332894	0.004287	0.135907	0.329998	0.534095
H1	0.022084	0.524240	0.018514	0.457247	0.003791	0.002216	0.303774	0.694010
H2	0.021983	0.549441	0.029447	0.421112	0.003762	0.000160	0.372234	0.627607
LOIBES	0.019976	0.497543	0.054284	0.448173	0.003862	0.024277	0.393426	0.582296
HIIBES	0.015523	0.259594	0.164169	0.576237	0.007714	0.271791	0.427370	0.300839
MNIBES	0.016985	0.402709	0.070179	0.527112	0.004788	0.145380	0.371762	0.482858
MDIBES	0.017053	0.407406	0.068099	0.524495	0.004765	0.137865	0.376269	0.485865
VLGE	0.008016	0.421145	0.027156	0.551698	0.005437	0.509244	0.215029	0.275727
VLGD	0.010770	0.579033	0.011212	0.409755	0.001540	0.651789	0.000645	0.347566

Table 5.28
Decomposition of Forecast Error: Natural Gas Transmission Companies

	Errors Assessed Against Earnings Growth				Errors Assessed Against Dividend Growth			
	MSFE	BIAS	EFFICIENCY	RANDOM	MSFE	BIAS	EFFICIENCY	RANDOM
HD1	0.034168	0.298089	0.169983	0.531928	0.004296	0.222821	0.403705	0.373475
HD2	0.031354	0.288628	0.118861	0.592511	0.004455	0.166201	0.495615	0.338184
HD3	0.031679	0.308568	0.107301	0.584132	0.006700	0.292905	0.470115	0.236979
HD4	0.037306	0.330284	0.178878	0.490838	0.006699	0.343865	0.425695	0.230440
HE1	0.041756	0.353886	0.233819	0.412295	0.006676	0.454766	0.334762	0.210472
HE2	0.037909	0.137226	0.392459	0.470314	0.006544	0.030734	0.765526	0.203741
HE3	0.061313	0.269356	0.431959	0.298685	0.037222	0.033853	0.923991	0.042157
HE4	0.040911	0.385068	0.171147	0.443785	0.005816	0.459428	0.328336	0.212236
HB1	0.022558	0.067798	0.193431	0.738770	0.003500	0.339139	0.206331	0.454530
HB2	0.020288	0.125966	0.002384	0.871650	0.002488	0.194571	0.169679	0.635750
HB3	0.021855	0.102442	0.052130	0.845428	0.004585	0.110258	0.550049	0.339693
HB4	0.021660	0.091236	0.060953	0.847811	0.003339	0.307380	0.224752	0.467869
H1	0.021990	0.278800	0.008556	0.712644	0.002704	0.141882	0.194390	0.663728
H2	0.021664	0.269909	0.004077	0.726014	0.003144	0.120405	0.321768	0.557828
LOIBES	0.020926	0.221091	0.044907	0.734002	0.001356	0.007195	0.025714	0.967091
HIIBES	0.032206	0.342448	0.082710	0.574842	0.003311	0.208813	0.325396	0.465790
MNIBES	0.025465	0.271712	0.008213	0.720076	0.001808	0.047725	0.134675	0.817601
MDIBES	0.024926	0.254742	0.008754	0.736504	0.001849	0.025572	0.154283	0.820146
VLGE	0.012211	0.431255	0.016807	0.551938	0.012337	0.013028	0.865179	0.121792
VLGD	0.022277	0.478954	0.031078	0.489968	0.001316	0.161511	0.673375	0.165114

Table 5.29
Decomposition of Forecast Error: Natural Gas Distribution Companies

	Errors Assessed Against Earnings Growth				Errors Assessed Against Dividend Growth			
	MSFE	BIAS	EFFICIENCY	RANDOM	MSFE	BIAS	EFFICIENCY	RANDOM
HD1	0.070834	0.165116	0.072828	0.762056	0.005814	0.027073	0.242074	0.730854
HD2	0.083193	0.182824	0.532328	0.284848	0.005758	0.148291	0.095846	0.755863
HD3	0.074712	0.272686	0.026794	0.700520	0.008461	0.135662	0.337156	0.527182
HD4	0.066877	0.210179	0.010982	0.778839	0.007251	0.065606	0.328416	0.605977
HE1	0.059943	0.201052	0.027773	0.771175	0.006738	0.040581	0.307950	0.651469
HE2	0.074275	0.165834	0.249804	0.584362	0.004954	0.176907	0.036600	0.786492
HE3	0.071141	0.079897	0.190148	0.729955	0.029215	0.000010	0.845009	0.154981
HE4	0.065299	0.215793	0.002186	0.782021	0.006319	0.097557	0.203480	0.698962
HB1	0.056171	0.079792	0.000487	0.919721	0.006785	0.110172	0.247105	0.642723
HB2	0.053371	0.061762	0.034220	0.904018	0.009128	0.209341	0.301043	0.489616
HB3	0.065089	0.066234	0.172713	0.761053	0.018765	0.091400	0.666831	0.241769
HB4	0.056851	0.080235	0.001811	0.917954	0.006920	0.108769	0.250497	0.640734
H1	0.071122	0.134821	0.115699	0.749480	0.004128	0.007941	0.000021	0.992038
H2	0.066286	0.135029	0.139274	0.725697	0.004232	0.011210	0.037693	0.951097
LOIBES	0.064218	0.177944	0.008218	0.813838	0.004328	0.075631	0.010334	0.914036
HIIBES	0.077674	0.240399	0.122661	0.636940	0.007981	0.348043	0.122845	0.529112
MNIBES	0.069944	0.204709	0.059031	0.736260	0.005591	0.205374	0.054086	0.740540
MDIBES	0.069851	0.199839	0.063805	0.736356	0.005658	0.200105	0.063133	0.736762
VLGE	0.085891	0.339527	0.021223	0.639250	0.011345	0.321451	0.248286	0.430263
VLGD	0.064656	0.272589	0.020939	0.706472	0.005742	0.193696	0.184701	0.621603

Table 5.30
Decomposition of Forecast Error: Electric and Gas Combination Companies

	Errors Assessed Against Earnings Growth				Errors Assessed Against Dividend Growth			
	MSFE	BIAS	EFFICIENCY	RANDOM	MSFE	BIAS	EFFICIENCY	RANDOM
HD1	0.014007	0.513632	0.042831	0.443537	0.001040	0.249031	0.074517	0.676452
HD2	0.013666	0.470091	0.080000	0.449910	0.001078	0.157188	0.162532	0.680280
HD3	0.011533	0.341495	0.123058	0.535447	0.002850	0.026811	0.700942	0.272247
HD4	0.013596	0.475627	0.074758	0.449616	0.000875	0.163816	0.085177	0.751006
HE1	0.016850	0.538413	0.106473	0.355114	0.001423	0.508216	0.097137	0.394647
HE2	0.015935	0.409159	0.205360	0.385481	0.002464	0.058090	0.642669	0.299240
HE3	0.039315	0.002641	0.842083	0.155277	0.030303	0.108197	0.866611	0.025192
HE4	0.016244	0.501440	0.145428	0.353131	0.001307	0.411614	0.120241	0.468146
HB1	0.019528	0.585332	0.103007	0.311661	0.003485	0.481636	0.296013	0.222351
HB2	0.021109	0.606444	0.097779	0.295777	0.005138	0.431836	0.419034	0.149130
HB3	0.030604	0.447580	0.346446	0.205974	0.013592	0.216555	0.727291	0.056154
HB4	0.017918	0.577374	0.074704	0.347922	0.002998	0.415439	0.325230	0.259331
H1	0.015169	0.500171	0.058357	0.441472	0.001658	0.349643	0.176347	0.474010
H2	0.014882	0.483850	0.108841	0.407308	0.001467	0.222168	0.280298	0.497533
LOIBES	0.012960	0.392629	0.125368	0.482002	0.001867	0.008287	0.615951	0.375762
HIIBES	0.011568	0.069815	0.392233	0.537952	0.005481	0.255912	0.604456	0.139632
MNIBES	0.011423	0.239425	0.213646	0.546929	0.002713	0.080322	0.648383	0.271296
MDIBES	0.011526	0.257644	0.200206	0.542151	0.002597	0.061579	0.654950	0.283470
VLGE	0.008554	0.456639	0.005037	0.538324	0.001738	0.077041	0.571881	0.351078
VLGD	0.008482	0.372955	0.035749	0.591297	0.000982	0.554788	0.263334	0.181877

IBES methods but not found in the Value Line methods, and in only HD2, HE2, HB1, and HB4 of the historical methods.

The final Utility sector decomposition presented in Table 5.35 for the Electric and Gas Combination companies indicates that statistically significant linear biases were found in all of the forecast methods when actual earnings growth was employed. When dividend growth was taken as the measure of actual growth, the null hypotheses was rejected for all methods except MDIBES and MNIBES.

Table 5.31
Evaluation of Linear Bias and Inefficiency:
Telephones

	Earnings Growth		Dividend Growth	
	t-Statistic for			
	H_0:a=0	H_0:B=1	H_0:a=0	H_0:B=1
HD1	0.9130	-0.9716	0.1570	-0.5784
HD2	0.3910	-0.4628	-0.8350	0.2380
HD3	2.1570	-2.4171	0.4140	-1.2444
HD4	0.8390	-0.9682	0.1280	-0.6840
HE1	1.2760	-1.3178	-0.0430	-0.7771
HE2	1.6440	-1.7861	-0.1080	-4.3290
HE3	1.1310	-3.8930	0.2400	-0.7340
HE4	1.0150	-1.1124	0.4160	-1.4895
HB1	1.2540	-0.8824	0.3490	-2.1004
HB2	1.5600	-1.9820	-0.6590	0.1762
HB3	0.9360	-0.9080	0.3570	-1.7019
HB4	1.3510	-1.2885	0.1950	-0.5489
H1	1.1880	-1.1336	0.0630	-0.4506
H2	1.3420	-1.3107	0.8706	-0.6213
LOIBES	0.3870	-0.3994	-0.4580	-0.0047
HIIBES	0.6410	-0.8573	-0.7310	0.1918
MNIBES	0.8210	-0.9072	-0.3640	0.0361
MDIBES	0.9770	-1.0440	0.2570	-0.5263
VLGE	-0.8120	-5.0764	-6.3440	-13.1423
VLGD	-0.0080	-4.7777	-2.8070	-7.7111

Table 5.32
Evaluation of Linear Bias and Inefficiency:
Electric Service

	Earnings Growth		Dividend Growth	
	t-Statistic for			
	H_0:a=0	H_0:B=1	H_0:a=0	H_0:B=1
HD1	6.5110	-2.5947	0.1420	-0.2091
HD2	6.9690	-3.0449	0.9500	-1.4010
HD3	6.3390	-3.6352	0.0860	-1.7322
HD4	6.5240	-2.7489	0.1360	-0.4752
HE1	9.6620	-3.5396	1.8960	-0.9373
HE2	9.8020	-4.4362	3.2710	-5.0996
HE3	12.1540	-14.1365	4.2770	-15.6885
HE4	7.7180	-2.4282	1.1110	-0.5212
HB1	8.7880	-2.2041	1.5500	0.3137
HB2	12.0930	-2.4123	4.0200	-0.5252
HB3	13.6510	-7.3418	5.4160	-7.3917
HB4	8.0450	-2.0305	1.2680	0.1777
H1	7.3190	-2.4720	1.8890	-1.2804
H2	7.8660	-2.8855	2.1710	-1.7436
LOIBES	3.1940	-0.0682	0.0680	0.2608
HIIBES	4.1820	-2.0858	-1.5110	0.7915
MNIBES	3.6050	-1.2053	-1.0700	0.9174
MDIBES	3.8030	-1.2892	-0.8740	0.7164
VLGE	5.3350	-4.9738	0.6130	-6.5933
VLGD	3.9130	-3.4062	-3.8320	-7.5827

Table 5.33
Evaluation of Linear Bias and Inefficiency:
Natural Gas Transmission

	Earnings Growth		Dividend Growth	
	t-Statistic for			
	H_0:a=0	H_0:B=1	H_0:a=0	H_0:B=1
HD1	-0.5050	-0.8260	1.9540	-3.0777
HD2	-0.7440	-0.8082	2.1830	-3.4046
HD3	-0.8160	-0.3282	1.0160	-1.9023
HD4	-0.5680	-0.9467	2.0520	-3.6837
HE1	-0.3410	-0.8576	1.0500	-2.4957
HE2	-0.6600	-1.3811	2.9610	-4.6970
HE3	-0.5460	-2.8508	3.3610	-9.3357
HE4	-0.7810	-0.4159	0.7930	-2.3568
HB1	-0.6760	-1.1948	5.7440	-5.0910
HB2	-0.7240	-1.7861	4.5250	-8.1673
HB3	-0.7850	-4.1874	5.1070	-16.0356
HB4	-0.6910	-1.0837	5.7300	-5.1479
H1	0.6800	-1.8780	2.0000	-2.1904
H2	0.6010	-1.9137	1.9080	-2.3654
LOIBES	0.0540	-0.9771	0.6590	-1.2959
HIIBES	-0.8670	0.2241	-0.5370	-0.3822
MNIBES	-0.1940	-0.4339	-0.3040	-0.3898
MDIBES	-0.0270	-0.5534	-0.2940	-0.3257
VLGE	-2.1810	-2.2493	6.4490	-10.1290
VLGD	-3.4790	-2.0160	2.1930	-13.6694

Table 5.34
Evaluation of Linear Bias and Inefficiency:
Natural Gas Distribution

	Earnings Growth		Dividend Growth	
	t-Statistic for			
	H_0:a=0	H_0:B=1	H_0:a=0	H_0:B=1
HD1	1.9540	-3.0777	0.4890	-0.9062
HD2	2.1830	-3.4046	1.8720	-3.8797
HD3	1.0160	-1.9023	-0.5450	-0.4655
HD4	2.0520	-3.6837	-0.6010	0.1594
HE1	1.0500	-2.4957	-1.6540	0.9489
HE2	2.9610	-4.6970	0.6100	-2.2245
HE3	3.3610	-9.3357	-0.9120	-1.5566
HE4	0.7930	-2.3568	-0.6760	0.0722
HB1	5.7440	-5.0910	-2.4750	1.9131
HB2	4.5250	-8.1673	-1.3960	0.7358
HB3	5.1070	-16.0356	-1.7490	1.0229
HB4	5.7300	-5.1479	-2.4240	1.8312
H1	2.0000	-2.1904	0.1050	-0.8801
H2	1.9080	-2.3654	-0.1800	-0.6126
LOIBES	0.6590	-1.2959	1.6980	-2.7206
HIIBES	-0.5370	-0.3822	1.5230	-2.2532
MNIBES	-0.3040	-0.3898	3.0070	-3.8568
MDIBES	-0.2940	-0.3257	2.0640	-2.9700
VLGE	6.4490	-10.1290	-0.6610	-0.7055
VLGD	2.1930	-13.6694	-1.6140	-0.7892

Table 5.35
Evaluation of Linear Bias and Inefficiency:
Electric and Gas Combination

	Earnings Growth		Dividend Growth	
	t-Statistic for			
	H_0:a=0	H_0:B=1	H_0:a=0	H_0:B=1
HD1	7.1350	-3.1777	3.1990	-1.8826
HD2	7.2910	-3.2998	3.8710	-2.9404
HD3	9.0390	-5.6978	6.5050	-9.5592
HD4	7.7550	-3.9625	2.7490	-1.7745
HE1	12.2130	-5.8853	5.6870	-2.4558
HE2	11.1670	-6.3375	7.0070	-7.9727
HE3	13.1040	-19.8299	8.3450	-32.5252
HE4	10.7410	-5.3567	4.2910	-1.9682
HB1	12.4990	-4.4121	7.0800	-1.9227
HB2	11.7160	-3.2223	7.4310	0.4843
HB3	14.1490	-5.2162	12.3760	-3.4550
HB4	13.0130	-4.6589	8.3600	-3.6989
H1	7.6610	-3.4634	3.0370	-1.0904
H2	9.0760	-4.3475	4.1190	-2.3278
LOIBES	4.7170	-1.0525	2.2010	-0.6724
HIIBES	3.6470	-1.2998	1.9360	-2.6000
MNIBES	3.5940	-0.8925	1.3590	-0.9014
MDIBES	3.5210	-0.7238	1.3840	-0.7873
VLGE	6.5670	-4.9492	4.4960	-11.2014
VLGD	5.8140	-4.1604	1.2690	-18.1345

5.9 The Correlations of Forecast Methods to the Cross-Sectional Structure of Price Earnings Ratios

This final examination of forecast methods is addressed at the question of which growth forecast method is actually utilized by investors in forming their expectations. That is, as noted in Chapter 1, one of the most important aspects of a growth estimator for use in the DCF model is whether or not that estimator reliably proxies for actual investor expectations. The Cragg and Malkiel (1982) study suggests strongly that it is the consensus of security analysts' forecasts that is embodied in stock prices. However, that study is based on data derived in the 1960s and was limited to a few security analysts and a limited number of companies. This section of the analysis, following the initiative of Cragg and Malkiel, updates and expands the sample size to determine if their results continue to hold. Further, the analysis is also carried out an industry category level to determine if the relationships of the forecasts to the cross-sectional structure of price earnings ratios varies among the industrial groupings.

The theoretical basis for the empirical relationship to be examined follows from the constant growth DCF model,

$$P_0 = \frac{D_1}{(k - g)} \quad .$$

If both sides of the model are normalized to earnings per share,

$$\frac{P_0}{E} = \frac{D_1}{E} \frac{1}{(k - g)},$$

a relationship between the price earnings ratio and the product of the dividend payout ratio and the reciprocal of (k - g) is established. As noted in Chapter Four, this relationship is not linear and does not easily lend itself to linear estimating techniques if the the values of the variables are extreme. However, for realistic values of k, g, and the payout ratio, Cragg and Malkiel claim that a linear model of the form

$$\frac{P_0}{E} = \hat{a}_0 + \hat{a}_1 \frac{D_1}{E} + \hat{a}_2 (k) + \hat{a}_3 (g),$$

can be expected to capture the salient relationships implied by the constant growth model. The anticipated signs of the parameter estimates have the price earnings ratios increasing with the payout ratio, decreasing with increases in the cost of equity as the risk of the investment rises, and increasing with increases in the growth rate. Thus, the sign of a3, the estimated coefficient of the expected growth variable should be positive.

For the purpose of this study of competing growth forecasts it is not necessary to estimate the full model. That is, it is only necessary to demonstrate that a growth forecasting method is positively related to the price

earnings ratio in order to claim that method is embodied in investor expectations. If several methods are positively related, then the method with the largest correlation coefficient is regarded as the best proxy for investor expectations. This minimizes the structural assumptions that are required for implementation of the ordinary least squares model.

Table 5.36 presents the simple correlation coefficients between the fourteen forecasts by historical methods of long-term growth to occur from the beginning of 1982 and the respective price earnings ratio based on the most recently reported earnings and stock price at year-end 1981, as well as equivalent correlations between the IBES methods forecasts and the same price earnings ratios. The cross-sectional correlations across the aggregate sample for the forecasts by historical methods range from -28% to 23, but are generally are close to zero. Only four of the fourteen forecasts by historical methods correlations are statistically different from zero at normal confidence levels. All of the four IBES methods indicate the requisite positive correlation and each of these methods demonstrates a significant relationship with the cross-sectional structure of price earnings ratios, with the magnitude of the IBES correlations averaging about four times that of the historical methods correlations.

Table 5.36
Correlation Between Forecast Methods
and Price Earnings Ratios

HD1	0.10318
HD2	0.17667
HD3	0.00079
HD4	0.23742
HE1	-0.09454
HE2	-0.28965
HE3	-0.05575
HE4	0.08537
HB1	-0.05740
HB2	-0.12492
HB3	-0.09024
HB4	0.06465
H1	0.06019
H2	0.00158
LOIBES	0.33939
HIIBES	0.31354
MNIBES	0.40285
MDIBES	0.39760

Table 5.37 presents the correlations disaggregated by industrial grouping. As with many of the other results of this study, that table tends to confirm the industry specific nature of the relationships of the forecast methods. While the correlations of the individual historical methods with the price earnings ratios varies widely, on average those correlations are negative but very close to zero. In comparison the IBES forecast correlations are in the large, positive and significantly different from zero. As is readily seen, for all of the industry groups, the forecasts by historical methods average correlation coefficient is less than one. For the IBES methods, the average correlation for the Machinery, Real Estate, restaurants and Specialty Trade, Rubber, Plastic, and Leather, Service, and Transportation groups

Table 5.37
Correlation Between Forecast Methods
and Price Earnings Ratios
By Industry Category

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4
AGRICULTURE AND MINING	-0.051	0.097	-0.029	0.136	-0.276	-0.357	0.053	0.040
BANKING	0.474	0.435	0.385	0.343	0.333	0.015	0.029	0.328
CHEMICALS AND DRUGS	0.223	0.224	0.107	0.252	-0.188	-0.310	-0.130	-0.056
CONSUMER GOODS	-0.138	0.157	-0.146	-0.092	-0.469	-0.622	0.099	-0.458
ELECTRONICS	-0.143	0.169	0.052	-0.080	0.258	-0.103	0.191	0.332
FOOD AND BEVERAGE	0.064	-0.156	-0.199	0.314	-0.257	-0.451	-0.113	-0.193
FOREST PRODUCTS	0.106	0.112	0.103	0.261	-0.658	-0.733	-0.323	-0.476
MACHINERY	-0.167	-0.118	-0.174	0.069	-0.316	-0.352	-0.043	-0.220
METALS	-0.190	0.079	-0.077	-0.014	-0.499	-0.364	-0.291	-0.244
NON-BANK FINANCE	0.184	0.039	-0.045	0.183	-0.243	-0.358	-0.392	-0.152
OFFICE EQUIPMENT	0.437	0.635	-0.507	0.630	0.933	-0.301	-0.557	0.879
PETROLEUM REFINING	0.240	0.010	-0.227	0.170	0.132	-0.434	-0.186	0.289
PUBLISHING AND PRINT	0.257	0.030	0.069	0.200	0.049	-0.221	0.312	0.092
REAL ESTATE	0.213	-0.026	0.148	0.372	-0.387	-0.617	-0.529	-0.082
RESTAURANTS AND SPEC TRADE	0.415	0.514	0.425	0.367	-0.093	-0.346	-0.525	0.159
RETAIL TRADE	0.520	0.661	0.095	0.634	-0.030	-0.336	0.052	0.217
RUBBER, PLASTIC, AND LEATHER	0.302	0.139	0.018	0.338	-0.018	-0.357	-0.534	0.023
SERVICE	0.273	0.428	-0.051	0.180	-0.281	-0.497	0.027	-0.191
STONE,CLAY,GLASS, AND CONCRET	0.141	0.403	-0.492	-0.153	-0.366	-0.496	-0.523	-0.154
TEXTILES	0.291	0.108	0.312	0.111	0.043	-0.295	-0.326	0.331
TRANSPORTATION	0.501	-0.025	-0.414	0.289	-0.116	-0.375	-0.270	0.043
TRANSPORTATION EQUIP	-0.382	-0.673	-0.440	-0.356	-0.646	-0.752	-0.300	-0.601
UTILITIES	0.361	0.385	0.237	0.200	-0.076	-0.314	-0.146	-0.037
WHOLESALE TRADE	-0.006	-0.270	-0.317	-0.051	-0.437	-0.435	0.140	-0.293

TABLE 5.37--continued

	HB1	HB2	HB3	HB4	H1	H2	LOIBES	HIIBES	MNIBES	MDIBES
AGRICULTURE AND MINING	-0.295	-0.169	-0.016	-0.093	-0.152	-0.122	0.552	0.514	0.581	0.573
BANKING	-0.082	-0.355	-0.466	0.097	0.418	0.484	0.129	0.260	0.205	0.185
CHEMICALS AND DRUGS	0.026	-0.003	-0.065	0.074	0.033	-0.062	0.127	0.350	0.247	0.189
CONSUMER GOODS	0.193	0.139	-0.123	0.261	-0.274	-0.456	0.525	0.223	0.608	0.628
ELECTRONICS	0.024	-0.256	-0.027	-0.020	-0.088	-0.104	0.164	0.410	0.307	0.284
FOOD AND BEVERAGE	-0.160	-0.107	0.107	-0.120	-0.009	-0.167	0.192	0.059	0.125	0.128
FOREST PRODUCTS	-0.002	-0.032	-0.059	0.150	-0.087	-0.404	0.025	0.307	0.236	0.166
MACHINERY	-0.091	-0.175	-0.203	-0.047	-0.151	-0.116	-0.204	-0.173	-0.227	0.220
METALS	0.141	0.182	0.113	0.067	-0.318	-0.479	-0.108	0.040	0.056	0.099
NON-BANK FINANCE	-0.284	-0.173	-0.644	-0.385	0.157	-0.117	0.208	0.212	0.261	0.263
OFFICE EQUIPMENT	0.090	-0.422	-0.629	0.018	0.218	0.048	-0.721	0.528	0.082	0.030
PETROLEUM REFINING	0.345	0.010	0.038	0.368	-0.171	-0.500	0.290	-0.033	0.297	0.352
PUBLISHING AND PRINTING	-0.143	-0.373	-0.401	-0.052	0.086	0.127	0.477	0.208	0.361	0.256
REAL ESTATE	0.193	-0.118	-0.022	0.176	0.621	0.583	-0.363	0.089	-0.227	0.261
RESTAURANTS AND SPEC TRADE	-0.355	-0.029	-0.185	-0.354	0.074	0.010	-0.164	-0.056	-0.109	0.109
RETAIL TRADE	0.049	-0.098	-0.111	0.110	-0.002	-0.345	0.172	0.296	0.232	0.220
RUBBER, PLASTIC, AND LEATHER	0.079	-0.148	0.142	0.005	0.048	-0.080	-0.047	0.057	-0.087	0.124
SERVICE	-0.129	-0.252	-0.239	-0.024	-0.081	-0.278	-0.093	-0.120	-0.131	0.157
STONE, CLAY, GLASS, AND CONCRETE	-0.154	-0.409	0.032	-0.081	-0.067	-0.226	0.038	0.664	0.320	0.195
TEXTILES	0.154	0.421	0.037	0.088	0.223	-0.053	-0.051	0.039	-0.003	0.015
TRANSPORTATION	-0.038	-0.187	-0.080	-0.077	-0.393	-0.340	-0.249	0.341	0.006	0.110
TRANSPORTATION EQUIP	0.149	-0.128	-0.122	0.077	-0.570	-0.594	-0.022	0.776	0.778	0.176
UTILITIES	-0.095	-0.135	-0.121	-0.000	0.023	0.022	0.367	0.507	0.502	0.498
WHOLESALE TRADE	-0.045	-0.166	-0.080	-0.012	-0.187	-0.166	0.553	0.001	0.342	0.493

were negative. For Textiles, the IBES correlation was about zero. For the remaining seventeen industrial categories, the coefficient was significantly positive.

These results are similar in nature to those reported by Cragg and Malkiel. Taken together, these results tend to support the view that the consensus forecasts of security analysts are an integral part of the formation of growth expectations by actual investors.

CHAPTER SIX

SUMMARY AND CONCLUSIONS

6.1 Introduction

This chapter concludes the study and examination of growth estimator methods by summarizing the findings of the earlier chapters and drawing overall conclusions from those findings. As noted at the outset, the primary purpose of this study is to evaluate the properties of competing methods of estimating the growth component of the constant growth discounted cash flow method of cost of equity determination. As such, this study presents the first known evaluation of the original IBES growth forecasts made in 1982. At the same time, a set of forecasts derived exclusively from historical data and chosen on the basis of the popularity of their usage in regulatory proceedings, is also evaluated. Through comparisons of the forecasts to actual growth outcomes, comparisons among the forecasts themselves, and the forecasts relationship to capital market data, the forecasts are examined to determine which, if any, of the forecast methods exhibit superior qualities.

In addition to the main empirical examinations of the study, a theory is developed in Chapter Two which explains the importance of the concept of a consensus forecast to

the determination of stock prices. This theory allows for the production of price exogenous information by security analysts and describes how risk averse investors, seeking to protect their investments, will obtain and utilize this information in the formation of their expectations. A logical conclusion to be drawn from this theory, is that the wealthy, less risk averse investors will acquire the best information about a security. This theoretical conclusion, in turn, strongly supports the supposition that the expectations of the large institutional investors, will tend to dominate in the consensus market expectation about the relevant economic parameters of a security's performance. Because these large institutional investors are known to be the primary clients of security analysts and the primary purchasers of the IBES consensus forecasts it is also reasonable to conclude that the IBES forecasts directly impact the expectations of the institutional investors. However, the actual market expectations cannot be observed and that prevents a direct testing of the theoretical predictions of that model. But the empirical findings of this study do tend to support the view that because of the informational efficiency of security analysts' forecasts, those forecasts will more likely be embedded in the consensus market forecast than any other type of forecast.

In Section 6.2 the empirical findings of Chapters Four and Five are used to draw conclusions about the

qualities of the various forecasts in terms of consistency, bias, and efficiency. In Section 6.3, a final examination is presented to demonstrate empirically the relative information efficiency of analysts' forecast versus the informational efficiency of historical forecast methods.

6.2 Findings

Consistency. In Chapter Four it is shown that the correlations among the various historical forecast methods are generally small, with the average correlation coefficient being only 24%. Such low correlations and the dispersion of the mean values of the fourteen forecasts by historical methods indicates that there is little agreement among computational methodologies, differing time periods, or data series. This has a direct bearing on the consistency of the historical forecast methods as long-term growth estimators. Significantly different growth estimates can be made for the same company by altering slightly the data period or the computational form. Further, the often negative correlations between the various forecasts by historical methods indicate that by choosing one data series over another, entirely different views of expected growth can be formulated. A more comprehensive examination of forecast agreement was also conducted through the use of Friedman tests of equivalence. That test indicated strongly that the

various forecasts by historical methods were producing distinct and different values across the entire sample of companies. In fact, in 80 of 91 pairwise evaluations of forecast agreement for the forecasts by historical methods, the null hypothesis of forecast equivalence was rejected at the 95 percent confidence level. In general, all of the statistics strongly indicate that the forecasts of the various forecasts by historical methods are different. That lack of agreement points out one of the more apparent weaknesses of using historically based forecasts. That is, with no clear right-or-wrong way to make forecasts based solely on accounting time series data, the results produced by selecting one method over another may differ significantly. This lack of consistency runs contrary to those who claim complete objectivity for historically based methods; for in fact, the subjective choice of method or data series drives the results.

This lack of consistency was not only observed at the aggregate sample level but also within industrial classifications. For example, for the Utility group, generally regarded as being the most stable of the industrial classifications, the correlations among forecasts by historical methods were also small, with many methods actually exhibiting negative correlations with other forecasts by historical methods. The computed Friedman statistics indicated that the hypothesis of

forecast equivalence could be rejected in eighty-six percent of the pairwise comparisons among the Utility group forecasts by historical methods.

By definition, the IBES consensus forecast is consistent. The value is computed from all of the individual forecasts obtained by IBES and is furnished to the user as a single value. The only possible inconsistency is in the choice of the mean or median value. As shown throughout the study, that choice is generally insignificant, as the cross-sectional distributions of those values are statistically equivalent.

On the basis of these examinations, it is concluded that forecasts by historical methods are not consistent and that the choice of data series, time period, or computational methodology can significantly alter the growth estimate.

Forecast accuracy. Although it cannot be stated categorically that the accuracy of the forecasts in predicting actual growth outcomes is necessarily related to usefulness of those forecasts in the formation of investor expectations, it is reasonable to believe that rational investors will seek to employ the most accurate forecasts.

The tests of forecasts accuracy presented in this study evaluate the relative and absolute performance of

the competing methods against the actual growth outcomes over the period 1982 to 1986.

The bases of comparison are both the observed growth in dividends per share and earnings per share. While implementation of the discounted cash flow model to estimate the cost of equity calls for an estimate of dividend growth, a meaningful case can be made that an estimate of earnings growth serves equally well. Further, if the assumption of constant dividend growth is being made in order to implement the DCF model, it would be internally inconsistent to assume that earnings are growing at a different rate. Thus, evaluations of forecast accuracy against both actual dividend and earnings growth are relevant to the determination of desirable estimating properties.

The primary metric for examining forecast accuracy is the squared forecast error and the mean square forecast error (MSFE). However, the study also present data about both the actual forecast error (APE) and the absolute percentage forecast error (APFE). As indicated by the APFE presented in Chapter Five, the absolute forecast accuracy of any of the historical or IBES forecasting methods as evaluated at the aggregate sample level is extremely poor. When errors were assessed against actual growth the median APFE values indicated the forecasts missed the actual growth rate by about 100 percent on average. The actual errors were generally positive thus

indicating the forecasts were producing estimates in excess of the actual observed growth. These aggregate results, however, tend to mask differences in forecasting accuracy at the industry level. Further, simply comparing mean errors ignores other important properties of the error distribution. The most powerful and efficient test of forecast accuracy over cross-sectional data that are (possibly) drawn from several unknown distributions makes use of the Wilcoxon Signed Ranks test. The indications of this test when applied at the aggregate sample level to the distribution of errors produced by examining actual earnings growth, were that the LOIBES method was a more accurate forecasting methodology than the historical methods in general, the HIIBES forecasts were generally less accurate than the forecasts by historical methods, a slight indication that the MNIBES forecasts were more accurate than the forecasts by historical methods, and some results that support weakly the inference that the MDIBES forecasts were more accurate than the forecasts by historical methods. When the dividend growth was used to establish the error distributions at the aggregate sample level, the Wilcoxon statistics indicated that the LOIBES was more accurate than the forecasts by historical methods, the HIIBES forecasts were generally less accurate than the forecasts by historical methods, there is weak evidence that the MNIBES and MDIBES forecasts were less accurate than the forecasts by historical methods. These

results are decidedly mixed and provide no indication of forecast superiority at the aggregate sample level of either MDIBES or the forecasts by historical methods. When both earnings growth and dividend growth errors are considered, these results tend to indicate that there is very little difference in the forecast accuracy of the IBES or forecasts by historical methods at the aggregate sample level. This is especially true if the IBES forecasts are limited to MNIBES and MDIBES, as is normally done.

Evaluating forecast accuracy at the industry level produces somewhat different conclusions. While there is significant dispersion in the error values, even casual inspection indicates that the forecast errors are much more similar within an industry than within a method. This is because a method or methods may be significantly more accurate than other methods within a particular industry but may be highly inaccurate within other industries.

In general, the pattern of forecast errors reported in Chapter Five tend to contradict the findings of Cragg and Malkiel (1982) regarding the relative ease of forecasting the growth of particular industries. Cragg and Malkiel found, contrary to intuition, that the Electric Utility industry proved to be one of the more difficult industries to predict, while the Petroleum Refining group was among the more correctly forecasted industries. The results reported here indicate just the

reverse. The Utility group demonstrates the smallest APFE on average across both the historical and IBES forecast methods, while the Petroleum Refining industry has the largest average APFE across forecast methods. The contrasting results may be the manifestation of the significantly different sample composition, in that Cragg and Malkiel were limited to an analysis of large, mature firms.

When the evaluations were carried out at the industry level, fourteen of the twenty-four industries indicated the average MSFE for IBES based methods is less than the average MSFE of the forecasts by historical methods for earnings growth errors, and twelve of the twenty-three industry group comparisons indicate smaller errors for the IBES methods when actual dividend growth was the basis.

Employing the Wilcoxon Signed Ranks test on the distribution of earnings based errors, indicated that in two industries, Banking and Utilities, the IBES forecasts were clearly more accurate than the forecasts by historical methods. Out of 56 total comparisons, (4 x 14), the IBES methods produced statistically significant smaller errors than the forecasts by historical methods in 42 (75%) comparisons for the Banking group, and in 43 (76.8%) comparisons for the Utility group. In two groups, Electronics and Machinery, the forecasts by historical methods produced smaller errors than the IBES forecasts in 32 (57%) and 30 (53.4%), respectively, of

the 56 comparisons. There was no evidence of marginal forecast superiority in any of the other industries. The significant Wilcoxon statistics indicates that the HIIBES forecasts were generally the poorest of the IBES methods, while the LOIBES forecasts indicated slightly better accuracy than the MDIBES or MNIBES forecasts. If the comparisons are limited to the MNIBES and MDIBES forecasts as is normally done when growth estimates are utilized in cost of capital studies, the general conclusions remain unchanged. In 26 of 28 (92.8%) comparisons for the Banking group, the MNIBES and MDIBES indicated smaller forecast errors. In 22 of 28 (78.6%) comparisons for the Utilities group, the MNIBES and MDIBES indicated smaller errors than the forecasts by historical methods. And, the historical methods tended to indicate smaller errors for the Electronics and Machinery groups, with 14 (50%) and 16 (57.1%), respectively, of the 28 comparisons favoring the forecasts by historical methods. For the remainder of the industry groups, no significant difference in forecast accuracy was found between the IBES forecasts and forecasts by historical methods.

When the Wilcoxon statistics were computed on errors are based on actual dividend growth, three of the twenty-four industry groups indicated that the historical methods produced more accurate forecasts. Chemicals and Drugs, Consumer Goods, and Machinery each had more than fifty percent of the Wilcoxon statistics in favor of the

historical methods, with 30, 31, and 29 total significant negative values out of 56 comparisons, respectively. For the remaining 21 industry groups, no significant difference between the IBES and historical method forecast errors was indicated. The Utility group did indicate somewhat better performance for the IBES based methods, although the number of favorable tests were not conclusive. It is clear, however, that the HIIBES method was significantly inferior to historical methods.

In sum, at the industry level, the MNIBES and MDIBES forecasts indicated superior forecast accuracy for two groups, Banking and Utilities, when forecasting actual earnings growth, and slightly superior forecast accuracy when forecasting dividend growth for the Utilities. For the remainder of the industrial groupings, when evaluated across both actual earnings and dividend growth, no clearly superior forecast accuracy for any method was detected. An additional examination of forecast accuracy was conducted for the companies that make up the Utility group. In addition to the fourteen historical and four IBES forecasts under study, this utility-sector examination allowed introduction of two additional forecasts made by the <u>Value Line</u> investor service. These utility companies were categorized into the various sectors that make up the regulated utility industry; Telephones, Electric Service, Natural Gas Transmission,

Natural Gas Distribution, and Electric and Gas Service companies.

Examination of the APFE assessed against earnings growth indicated that the smallest forecast errors were exhibited by the Telephones, followed in order, by the Electric Services, Electric and Gas Combinations, Natural Gas Distribution, and Natural Gas Transmission. The within sector comparisons of historical versus IBES methods consistently indicated that the average of the IBES methods produced smaller APFE than the average historical forecast method. The _Value Line_ forecasts were consistently more accurate in terms of APFE than the forecasts by historical methods across sectors but were mixed in comparison with the IBES consensus forecasts.

The APFE computed on the basis of actual dividend growth again indicated that the IBES forecasts produced smaller errors than the average forecast by historical methods. On average, the IBES forecasts produced APFE that were 31 percent smaller than the forecasts by historical methods APFE. If consideration is limited to the MNIBES and MDIBES, the average APFE for the MNIBES and MDIBES forecasts were about 38 percent smaller than the forecasts by historical methods APFE. The _Value Line_ forecasts indicated an average APFE that was almost equal to the average forecast by historical method APFE but about 50 percent greater than the average of IBES methods APFE.

The Wilcoxon Signed Ranks tests were again employed to more examine the full distributional properties of the forecast In general, the signs of those results indicate that the IBES based methods were clearly superior to the historical methods in forecasting earnings growth for all utility sectors. Statistically significant comparisons favoring the IBES forecasts occurred in 12 (of 56) tests for the Telephones, in 43 tests for the Electric Service companies, in 5 tests for the Natural Gas Transmission companies, in 4 tests for the Natural Gas Distribution companies, and in 43 tests for the Electric and Gas Combination companies. Statistically significant tests favoring the historical methods occurred in none of the tests for the Telephones, Electric Service companies, Natural Gas Transmission, or Natural Gas Distribution companies, and in only one test for the Electric and Gas Combination companies. The signs of the reported results indicate that the Value Line forecasts were also superior to the forecasts by historical methods in terms of producing smaller forecast errors, but roughly equivalent to the IBES forecasts. Statistically significant tests statistics favoring Value Line forecasts over the IBES methods occurred in 7 of 20 total pairwise comparisons across the five utility sectors. The signs of the results also indicate the IBES methods were superior to the forecasts by historical methods in terms of forecast accuracy for actual dividend growth for the Telephones,

Natural Gas Transmission, and Natural Gas Distribution companies, but inferior in forecast accuracy for the Electric Service companies. These data also indicate that the IBES methods were roughly equal in forecast accuracy with the forecasts by historical methods in forecasting dividend growth for the Electric and Gas Combination companies.

Statistically significant statistics favoring the IBES forecasts over the forecasts by historical methods occurred in 1 test for the Telephones, in 6 tests for the Electric Service companies, in 6 tests for the Natural Gas Transmission companies, in 13 tests for the Natural Gas Distribution companies, and in 11 tests for the Electric and Gas Combination companies. Significant statistics favoring the historical methods forecasts were observed in 21 tests for the Electric Service companies and 11 tests for the Electric and Gas Combination companies, but in none of the tests for the other utility sectors. The signs of the statistics indicate that the Value Line forecasts were about equivalent to both the IBES forecasts and the forecasts by historical methods in terms of consistency in producing the smallest forecast errors about dividend growth. If consideration is limited specifically to the Value Line dividend growth forecast, the results indicate that that Value Line method was superior in terms of forecast accuracy to the forecasts by

historical methods but again about equal to the IBES methods.

The empirical results for the companies in the Utility group indicate that the IBES forecasts were clearly superior to forecasts by historical methods in forecasting earnings growth for all of the individual utility sectors examined. The IBES methods were superior in forecast accuracy to the historical methods in forecasting actual dividend growth for the Telephone, Natural Gas Distribution, and Natural Gas Transmission companies, about as accurate for the Electric and Gas Combination companies, and less accurate for the Electric Service companies. The Value Line forecasts exhibited patterns of forecast errors that were very similar to the patterns of errors for the the IBES consensus forecasts.

Systematic biases in the forecasts. Through decomposition of the forecast errors it is possible to detect systematic linear biases in the forecasts. Employing techniques attributable to Theil and others, an examination of the sources of systematic biases was carried out at the aggregate sample level, the industry grouping level, and specifically for the companies in the Utility group.

Those examinations indicate that the IBES based forecast methods exhibited at the aggregate sample level, on average, less systematic linear bias than the historically based forecasts. Tests at the industry level

indicated that in 15 of the 24 industry groups, the forecast error attributable to linear bias was smaller for the IBES forecasts than for the historical forecasts when evaluated against earnings growth. However, when the MSFE were based on dividend growth, twenty-two of the twenty-four industries indicated that the forecasts by historical methods had smaller contributions to total error attributable to linear biases although none of those statistics were significant at normal confidence levels.

For the companies within the Utility group, for the Telephone sector, when errors are assessed against earnings growth, the null hypotheses of the absence of linear biases are rejected at normal confidence levels for HD3, HE3, and HB2 of the historical methods, and both VLGE and VLGD of the Value Line methods. The null hypotheses could not be rejected for the IBES forecasts. When errors were assessed against actual dividend growth, the null hypotheses were rejected for the Value Line forecasts and historical methods HE2 and HB1. The null hypotheses that the forecast method did not exhibit systematic linear bias could not be rejected for the IBES methods. Within the Electric Service companies, the absence of linear bias was rejected in all of forecast methods, when errors were assessed against earnings growth. When the actual dividend growth rate was used as the standard, the null hypotheses were rejected for all 14 forecasts by historical methods and for both VLGE and VLGD. The

presence of linear bias was not statistically significant in any of the four IBES forecasts. For the Natural Gas Transmission companies, when using actual earnings growth, the statistics indicate that historical methods HE3, HB3, H1 and H2, and Value Line methods VLGE and VLGD exhibited significant linear bias. The dividend growth results indicate rejection of the null hypotheses for all of the forecasts by historical methods as well as the Value Line methods, but not for any of IBES methods. For the Natural Gas Distribution companies, the null hypotheses were rejected for all of the forecasts by historical methods and for the Value Line methods when the statistics were based on actual earnings growth. The null hypotheses could not be rejected for any of the tests on the IBES forecasts. Almost the opposite results were found when the regressions were computed with the dividend growth rates. In that instance, statistically significant linear biases were detected for each of the IBES methods but not found in the Value Line methods, and in only HD2, HE2, HB1, and HB4 of the historical methods. And, finally, the tests for the Electric and Gas Combination companies indicate that statistically significant linear biases were found in all of the forecast methods when actual earnings growth was employed. When dividend growth was taken as the measure of actual growth, the null hypotheses was rejected for all methods except MDIBES and MNIBES.

It is concluded that linear bias is less significant and less of a problem in the IBES forecasts than in the forecasts by historical methods at all levels of aggregation or measurement of forecast error. This is especially true for the forecasts made for the Utility companies, where the IBES forecasts for three of the five utility sectors exhibited no linear bias. This conclusion is directly related to the information efficiency of the forecast methods. Information efficiency will be evaluated further in Section 6.3.

Relationship between competing forecasts and market data. Following Cragg and Malkiel, an examination of the correlations among the competing methods forecasts and the price earnings ratios of the underlying stocks was performed. According to implications of the constant growth discounted cash flow model, if investors are using a particular method of estimating growth, the correlation, on average, between that method and the price earnings ratios should be positive and significantly larger than the correlations produced by other forecast methods. In this study, the cross-sectional correlations across the aggregate sample for the forecasts by historical methods range from -28% to 23, but are generally are close to zero. Only four of the fourteen forecasts by historical methods correlations are statistically different from zero at normal confidence levels. All of the four IBES methods indicate the requisite positive correlation and each of

these methods demonstrates a significant relationship with the cross-sectional structure of price earnings ratios, with the magnitude of the IBES correlations averaging about four times that of the forecasts by historical methods correlations.

When this analysis was performed at the industry level, the correlations of the individual forecasts by historical methods with the price earnings ratios varied widely, but on average those correlations are negative but very close to zero. In comparison, the IBES forecast correlations are, in general, large, positive and significantly different from zero. For all of the industry groups, the forecasts by historical methods average correlation coefficient is less than zero. For the IBES methods, the average correlation for the Machinery, Real Estate, Restaurants and Specialty Trade, Rubber, Plastic, and Leather, Service, and Transportation groups were negative. For Textiles, the IBES correlation was about zero. For the remaining seventeen industrial categories, the coefficient was significantly positive

These results support the findings of Cragg and Malkiel, that the cross-sectional structure of share prices is better explained by the use of the consensus of the forecasts of growth made by security analysts' forecasts than through the use of historically derived forecasts of future growth.

Overall, there is no single test statistic or finding in this study that implies that the IBES forecasts are the only source of forecast information used by investors, or that the IBES forecasts dominate entirely other forecast methods. However, the bulk of the findings indicates that utilization of the IBES forecasts in cost of capital studies will,in general, fulfill the properties of estimators equally as well as the forecasts by historical methods. For regulated utility companies, there is substantial evidence that the IBES consensus forecasts, either the mean or median, will provide better forecasts of future growth than any forecast by historical method that is chosen ex ante.

6.3 An Explanation for the Superior Performance of Security Analysts' Forecasts

The purpose of this section is to conduct some simple empirical examinations of security analysts' forecasts to determine if, in fact, they are informationally efficient. More precisely, following the schematic of tests of stock market efficiency, if an informational event can be identified that in theory should have predictable consequences on growth expectations, then the forecast method which most quickly and fully revises its forecast in keeping with the theoretical prediction is considered to be the more informationally efficient forecast.

Across the full spectrum of industries, specific identification of common informational events that have predictable, systematic impacts on growth expectations is most likely impossible.[1] However, if the examination is restricted to regulated utility companies, the periodic revisions to these firms' authorized rates of return on common equity does constitute an informational event with a relatively predictable consequence on future growth. From the constant growth discounted cash flow model, expected future growth (g) is the product of the firm's earnings retention rate (b) multiplied by the expected earned rate of return on common equity (E(ROE)),

$$g = b \times E(ROE)$$

As shown in the table below, the earnings retention policy for the utility industry has been relatively stable through time. Therefore, to a first approximation, it is reasonable to treat b as a constant, and to treat changes in g as primarily resulting from changes in E(ROE). And, although E(ROE) will be the result of many economic and regulatory environmental factors, one primary factor is the authorized rate of return, AROE. The columns labeled "b" and "ROE" are the averages of actual earnings retention rates and earned return on common equity, respectively, for all regulated companies with SIC codes

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[1]The recent changes in the Federal tax code may be an exception. Data, however, are not yet available to evaluate this possibility.

4811, 4911, 4924, and 4931. The column labeled "AROE" is the average of all newly authorized returns on common equity for firms having rate case

Table 6.1
Average Earnings Retention and
Earned Rates of Return

Year	b(1)	ROE(1)	AROE(2)	R_f(3)
1975	35.21%	11.38%	12.85%	7.91%
1976	36.17	11.44	12.93	8.23
1977	34.43	11.41	13.10	7.30
1978	35.06	11.47	12.94	7.87
1979	33.46	11.70	13.17	8.99
1980	33.72	11.76	13.91	10.18
1981	32.49	12.15	15.54	11.99
1982	32.93	12.23	15.82	14.00
1983	33.66	13.03	15.26	10.66
1984	35.79	13.20	15.18	11.97
1985	32.50	12.14	15.16	12.48
1986	NA	NA	14.47	7.85

Sources: (1) Compustat, (2) Merrill Lynch Utility Industry and (3) Federal Reserve Statistical Release.

decisions in that year. Thus, AROE is, in a sense, the marginal authorization while ROE is the average historical earnings. Given that it takes about twelve months for a newly authorized rate of return to be reflected fully in the reported accounting results, AROE is a leading indicator of the direction that actual earned returns (ROE) will be moving. Increases or decreases in the current AROE show up as increases or decreases in ROE about a year later, although the magnitudes of the changes are not necessarily proportional or equivalent.

Both ROE and AROE are used as proxies for the unobservable E(ROE) and it follows , that the direction

of the response of E(ROE) should be the same as the direction of the change in AROE. That is,

$$\partial E(ROE) / \partial AROE > 0.$$

Further, since g is a positive function of E(ROE), changes in AROE should impact g in the same direction,

$$\partial g / \partial AROE > 0.$$

From this model, a simple testable hypothesis about the informational efficiency of different forecast methods can be established:

> H0: Growth forecasts produced by forecast method i change in the same direction as the change in the authorized rate of return.

Failure to accept the null hypothesis for some forecast method 1 while accepting it for a competing forecast method j provides evidence of the superior information efficiency of method j. At this point, it is obvious that simple, naive extrapolation of historical time series cannot capture the impact of this informational event at the time it occurs. Thus, almost by definition, forecasts by historical methods for regulated companies cannot be informationally efficient.

However, it remains to be demonstrated that security analysts' forecasts are informationally efficient, at least with respect to this identifiable information event. In order to provide validation for the use of security analysts' forecasts of growth in the discounted cash flow method of estimating the cost of capital, it is necessary

to show that informational efficiency exists at a company level as well as at an aggregate level. To explore the relative efficiency of security analysts' forecasts, a test was devised to determine if the revisions to security analyst forecasts were being driven solely by macroeconomic factors such as the change in the inflation rate or by company-specific information events such as new authorized rates of return. Because AROE and the inflation rate are highly correlated, an analysis at an aggregate level can not determine if the analysts' growth forecasts are being changed for all firms due simply to lower general inflationary expectations or if the analysts' are actually taking into account the company-specific information events that are associated with rate case determinations.

From the publication, Major Rate Case Decisions, a listing was made of all firms that experienced a change to their authorized rate of return on common equity in 1985 and 1986.[2] This period was selected for both timeliness and the amount of regulatory activity that occurred , and

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[2]Major Rate Case Decisions is published quarterly by Regulatory Research Associates. The publication lists the rate case determinations for all investor owned electric, gas, and telephone companies in the United States, and gives the date of the authorization, the previous authorized return, the new authorized return, and numerous other statistics. The correctness of the data is cross-validated with company officials and regulatory commission staff members.

because of the availability a data base of security analysts' forecasts that were made coincident with this period. The total number of companies experiencing new rate of return authorizations was 123. However, it was necessary to exclude several of these companies because of a lack of analysts' forecast data. Also, when an operating subsidiary of a publicly traded parent company experienced a new return authorization, the effect on the traded parent company was captured by calculating an implicit authorization for the parent as the weighted average of the vintage and/or authorizations of each of it subsidiaries. This technique further reduced the sample because on several occasions, two or more subsidiaries of the same parent experienced revisions in the same month, and the multiple changes were combined into one total change for the parent. The final sample consisted of 109 usable observations of companies experiencing a new rate of return authorization.

Next the IBES data base was used to obtain the consensus analyst forecast of long-term growth for each of the sample companies. The IBES service updates these forecasts on a monthly basis as the analyst themselves make new estimates of future growth. For the purposes of the study, observations of the growth forecasts were taken for each company at each month over the period September

1984 through February 1987. A forecast revision was calculated for each company i, as the first difference between monthly forecasts, or algebraically,

$$FR_{i,t} = Forecast_{i,t} - Forecast_{i,t-1}.$$

One monthly observation per company was lost to the differencing, so in total there were 29 monthly forecast revision observations per company.

Then using the month of the rate of return authorization date as the information event date, a time index was assigned to each forecast revision observation. That is, the month in which the rate of return was changed is taken as time 0, the month before the change occurred is -1, the month after the change is +1, and so forth. Beginning at the earliest available time before the new authorization and continuing through to the latest available time after the authorization, an average forecast revision (AFR) for the sample at time t was computed as

$$AFR_t = \sum FR_{i,t} / N ,$$

and the cumulative average forecast revision (CAFR) through time T was computed as

$$CAFR_T = \sum AFT_t \quad \text{for months } t = m \text{ to } t.$$

Note that the observations share a common period of event

time centered around time 0, but this will not necessarily represent a common period of calendar time.[3]

To contrast the analysts' forecast revisions for firms with a new rate of return authorization against firms that did not experience a rate of return change, a control sample of firms not experiencing a rate of return authorization throughout the period January 1985 to December 1986 was constructed in the following manner. From the SIC codes 4800 through 4900 (representing earnings regulated electric, gas, and telephone water companies), a company not experiencing a new rate of return authorization over the study period was randomly chosen. This company was paired with a company that did experience a new authorization, and a series of pseudo pre- and post-authorization analysts' forecast revisions was computed for the former company using the later company's new authorization date. A more refined matching technique that considers additional dimensions of similarity was not possible due to the limited total

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[3]Note also that the periods of time before and after a new rate of return authorization will not be the same for all companies. For example, a company that experienced a new authorization in December 1985 will have 14 pre-authorization observations and 14 post-authorization observations, while a company experiencing a new authorization in November 1986 has 25 pre-authorization observations and only 3 post-authorization revisions. However, statistically significant AFRs were observed only for the periods between 6 pre-authorization months and 6 post-authorization months. Ninety-three of the 109 companies had at least 6 pre- and 6 post-authorization observations.

number of companies within the industry group. However, the relative homogeneity of regulated firms is well documented and for the total sample the average characteristics of each group appear to be quite similar. For companies in the control group, the AFR_t, and $CAFR_T$ were also calculated.

In the table below the $CARF_T$ are shown by month for the 6 pre-authorization months, the authorization month, and the 6 post-authorization month for both the study sample and the control sample. The asterisks indicate statistical significance at the .05 level.[4]

Table 6.2
Comparison of Analysts' Revisions
Pre- and Post-Rate Authorization

	Firms Having New Rate of Return Authorization	Firms Not Experiencing Rate Case Decision (Control Sample)
Month	CAFR	CAFR
-6	-0.0450	-0.0371
-5	-0.0875*	+0.0043
-4	-0.1460*	-0.2100*
-3	-0.1733*	-0.1586
-2	-0.1775*	+0.2186*
-1	-0.2448*	-0.1971
0	-0.2632*	-0.1700
+1	-0.2660*	+0.0049
+2	-0.2766*	+0.1074
+3	-0.3549*	+0.1072
+4	-0.4489*	+0.0357
+5	-0.4666*	+0.0075
+6	-0.4726*	+0.0104

[4]The standard t-test is inappropriate due to the autocorrelation among the forecast revisions. The recommended technique is to correct for covariance between successive pairs of observations. The interpretation of the resulting statistic (p) is the same as for the standard t-statistic:

$$p_t = \sqrt{CAFR_t \;/\; [T \quad r^2\ (AFR_t) + 2(T - 1)COV(AFR_t, AFR_{t+1})]}.$$

For companies experiencing a change in their authorized rate of return, the consensus analyst forecast of growth begins to be revised in a systematic and significant manner about five months before the date of the new authorization, and the forecast revisions continue until about four months after the date of the new authorization. For the control group, the revisions to analysts' forecast appear to be random, generally insignificant, and without a systematic pattern. Note that the result for the control group does not rule out systematic revisions to the growth forecasts attributable to macroeconomic events. As was shown earlier, the growth forecasts for all regulated companies generally fell during the study period. However, in the matched pair construction, the control group showed no systematic tendencies vis a vis the companies experiencing a change in their authorized rate of return. Which in turn, strongly suggests that security analysts do, in fact, take into account company-specific informational events in making their forecasts.

If analysts use the authorized rate of return as <u>their</u> expectation of the future earnings level, then an additional implication of the DCF model is that the change to their growth forecast would be approximately the product of the retention rate multiplied times the change in the authorized rate of return. A cross-sectional linear regression of the total forecast revision on the

change between the old and new authorized rates of return should produce an estimated slope coefficient equal to the industry average long run earnings retention rate,

$$g_i = \hat{a}_0 + \hat{a}_1 [AROE_{i,NEW} - AROE_{i,OLD}],$$

implies, H_0: $a_1 = b$ where b = industry retention rate.

In keeping with the results already presented, the total forecast revision, ∂g, was measured as the cumulative forecast revision for company i at the sixth month after the new rate of return authorization. The difference in the old and new authorizations was calculated directly. The resulting parameter estimates and associated statistics are shown below:

	$\hat{a}_0$	$\hat{a}_1$
Estimate	0.084201	0.360102
Standard Error	0.201130	0.154981
t-statistic	0.419	2.324

From the Table 6.1 in this section, the long run average earnings retention rate for the industry is about .341, remarkably close to the parameter estimate from the regression. At any generally acceptable level of confidence, the null hypothesis of equivalence between the parameter estimate and the industry retention rate can not be rejected.

At first inspection, it would seem that the results indicate analysts are simply using the b x E(ROE) method of estimating future growth and using AROE as their

estimate of E(ROE). However, the amount of cross-sectional variation in g explained by the the change in authorized rates of returns was only about ten percent, indicating that the growth forecasts for individual companies incorporate more than just the knowledge of the authorized rates of return.

Conversations with individual security analysts do indicate that rate case results are a critical determinant of their forecasts, but they also indicate that other factors including their assessment of the company's potential sales growth, the company's ability to control costs, and other intangible factors such as management ability contribute to the growth forecasts. In all circumstances, it is clear that security analysts' forecasts include more information that is found in naive extrapolations of historical time series data.

BIBLIOGRAPHY

Abdel-Khalik, A. Rashad, and Ajinkya, Bipin B. "Returns to Informational Advantages: The Case of Analysts' Forecast Revisions," The Accounting Review, vol. 57, October 1982, 661-681.

Akerloff, George. "The Market for 'Lemons': Qualitative Uncertainty and the Market Mechanism," Quarterly Journal of Economics, vol. 89, August 1970, 488-500.

Alexander, Gordon J., and Francis, Jack Clark. Portfolio Analysis, Third Edition, Englewood Cliffs, New Jersey: Prentice-Hall, 1986.

Arrow, Kenneth J. "The Role of Securities in the Optimal Allocation of Risk Bearing," Review of Economic Studies, vol. 31, April 1964, 91-96.

Arrow, Kenneth J. Essays in the Theory of Risk Bearing, Chicago: Markham Publishing Company, 1971.

Bailey, Elizabeth. Economic Theory of Regulatory Constraint. Lexington, Massachusetts: Lexington Books, 1971.

Barefield, Russell, and Comiskey, Eugene E. "The Accuracy of Analysts' Forecasts of Earnings per Share," Journal of Business Research, vol. 50, July 1975, 241-252.

Basi, Bart A., Carey, Kenneth J., and Twark, Richard D. "A Comparison of the Accuracy of Corporate and Security Analysts' Forecasts of Earnings," The Accounting Review, April 1976, 244-254.

Baumol, William J. Testimony before the National Telecommunications Information Agency, Docket 61091-61941, Notice of Inquiry on the Appropriateness of Rate of Return Regulation in the Interexchange Industry, Washington, D.C.: National Telecommunications Information Agency, 1986.

Baumol, William J., Panzar, J.C., and Willig, R.D. "On the Theory of Perfectly Contestable Markets," in New Developments in the Analysis of Market Structure, Edited by Joseph E. Stiglitz and G. Frank Mathewson, Cambridge, Massachusetts: The MIT Press, 1986.

Bjerring, James H., Lanoishok, Joseph, and Vermaelen, Theo. "Stock Prices and Financial Analysts' Recommendations," Journal of Finance, vol. 38, no. 1, March 1983, 187-204.

Bluefield Water Works and Improvement Company v. Public Service Commission of West Virginia, 262 U.S. 679, (1923).

Blume, Marshall, and Friend, Irwin. "The Asset Structure of Individual Portfolios and Some Implications for Utility Functions," Journal of Finance, vol. 30, May 1975, 585-604.

Bosch, Jean-Claude. "Speculation and the Market for Recommendations," Journal of Financial Research, vol. 6, no. 2, Summer 1983, 103-113.

Breyer, Stephen. Regulation and Its Reform, Cambridge, Massachusetts: Harvard University Press, 1982.

Brigham, Eugene F., and Vinson, Steve R. "Value Line Forecasts Versus the Forecasts of Other Analysts," unpublished working paper, University of Florida, 1980.

Brigham, Eugene F., Vinson, Steve R., and Shome, Dilip K. "Estimating g for Use in the DCF Model," unpublished working paper, University of Florida, 1983.

Brown, Lawrence D., and Rozeff, Michael S. "The Superiority of Analyst Forecasts as Measures of Expectations: Evidence from Earnings," Journal of Finance, vol. 33, no. 1, March 1978, 1-16.

Brown, Lawrence D., and Rozeff, Michael S. "Univariate Time Models of Earnings per Share: A Proposed Model," Journal of Accounting Research, vol. 17, no. 1, Spring 1979, 179-189.

Brown, Stephen J., and Sibley, David S. The Theory of Public Utility Pricing, Cambridge: Cambridge University Press, 1986.

Carleton, Willard, and Vanderweide, James. Testimony in Federal Communications Commission Docket 84-800, Investigation of the Authorized Rate of Return for the Interstate Services of AT&T and Local Exchange Carriers, Washington, D.C.: Federal Communications Commission, 1985.

Chant, Peter. "On the Predictability of Corporate Earnings per Share Behavior," Journal of Finance, vol. 35, no. 1, March 1980, 13-21.

Coggin, T. Daniel, and Hunter, John E. "Analysts' EPS Forecasts Nearer to Actual than Statistical Models," Journal of Business Forecasting, February 1983, 20-23.

Conover, W. J. Practical Nonparametric Statistics, Second Edition, New York: John Wiley and Sons, 1980.

Copeland, Ronald M., and Marioni, Robert J. "Executives' Forecasts of Earnings per Share versus Forecasts of Naive Models," Journal of Business, vol. 45, September 1972, 497-512.

Cragg, John G., and Malkiel, Burton G. "The Consensus and Accuracy of Some Predictions of the Growth of Corporate Earnings," Journal of Finance, vol. 23, 1968, 67-84.

Cragg, John G., and Malkiel, Burton G. Expectations and the Structure of Share Prices. Chicago: The University of Chicago Press, 1982.

Crichfield, Timothy, Dyckman, Thomas, and Lanonishok, Joseph. "An Evaluation of Security Analysts' Forecasts," The Accounting Review, vol. 53, no. 3, July 1978, 651-668.

Deschamps, Benoit, and Mehta, Dileep R. "Predictive Ability and Descriptive Validity of Earnings Forecasting Models," Journal of Finance, vol. 35, no. 4, September 1980, 933-949.

Diamond, Douglas W., and Verrecchia, Robert E. "Information Aggregation in a Noisy Rational Expectations Economy," Journal of Financial Economics, vol. 9, 1981, 221-235.

Elton, Edwin J., and Gruber, Martin J. "Earnings Estimates and the Accuracy of Expectational Data," Management Science, vol. 18, no. 8, April 1972, B-409 to B-424.

Elton, Edwin J., and Gruber, Martin J. "Professional Expectations: Accuracy and Diagnosis of Errors," unpublished working paper, New York University, April 1983.

Elton, Edwin J., and Gruber, Martin J. Modern Portfolio Theory and Investment Analysis, Second Edition, New York: John Wiley and Sons, 1984.

Elton, Edwin J., Gruber, Martin J., and Gultekin, Mustafa. "Expectations and Share Prices," Management Science, vol. 27, no. 9, September 1981, 975-987.

Fama, Eugene F. "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance, vol. 25, May 1970, 383-417.

Faulhaber, Gerald. "Cross-Subsidization: Pricing in Public Enterprise," American Economic Review, vol. 65, 1975, 966-977.

Faulhaber, Gerald. "Subsidy Free Prices and Anonymous Equity," American Economic Review, vol. 71, 1981, 1083-1091.

Federal Power Commission v. Hope Natural Gas Company, 320 U.S. 391, (1944).

Figlewski, Stephan. "Market 'Efficiency' in a Market with Heterogeneous Information," Journal of Political Economy, vol. 86, August 1978, 581-597.

Fisher, Irving. The Rate of Interest, New York: American Economic Association, 1907.

Friend, Irwin, and Blume, Marshall. "The Demand for Risky Assets," American Economic Review, vol. 65, December 1975, 900-922.

Givoly, Dan, and Lakonishok, Joseph. "The Information Content of Financial Analysts' Forecasts of Earnings," Journal of Accounting and Economics, vol. 1, 1979, 165-185.

Gordon, Myron J. The Investment, Financing and Valuation of the Corporation, Homewood, Illinois: Richard D. Irwin, 1962.

Gordon, Myron J. The Cost of Capital to a Public Utility, East Lansing, Michigan: The Institute of Public Utilities, 1974.

Green, David, and Segall, Joel. "The Predictive Power of First-Quarter Earnings Reports," Journal of Business, vol. 40, 1967, 44-55.

Grossman, Sanford. "On the Efficiency of Competitive Stock Markets Where Traders Have Diverse Information," Journal of Finance, vol. 31, 1976, 573-585.

Grossman, Sanford, and Schiller, Robert J. "The Determinants of the Variability of Stock Market Prices," American Economic Review, vol. 71, May 1971, 222-227.

Grossman, Sanford, and Stiglitz, J.E. "Information and Competitive Price Systems," American Economic Review, vol. 66, May 1976, 246-253.

Grossman, Sanford, and Stiglitz, J.E. "On the Impossibility of Informationally Efficient Markets," American Economic Review, vol. 70, June 1980, 393-408.

Harrington, Diana. The Capital Asset Pricing Model in Public Utility Rate Cases, unpublished Ph.D. Dissertation, University of Virginia, 1979.

Ibbotson, Roger G., and Sinquefield, Rex A. Stocks, Bonds, Bills and Inflation: The Past and The Future, Charlottesville, Virginia: The Financial Analysts Research Foundation, 1982.

Iman, R.L., and Davenport, J.M. "Approximations of the Critical Region of the Friedman Statistic," Communications in Statistics, vol. 21, 1979, 65-70.

Imhoff, Eugene A. "The Representativeness of Management Earnings Forecasts," The Accounting Review, vol. 53, no. 4, October 1978, 836-850.

Imhoff, Eugene A., and Pare, Paul V. "Analysis and Comparison of Earnings Forecast Agents," Journal of Accounting Research, vol. 20, no.2, Part 1, Autumn 1982, 429-439.

Jaggi, Bikki. "Further Evidence on the Accuracy of Management Forecasts vis-a-vis Analysts' Forecasts," The Accounting Review, vol. 55, no.1, January 1980, 96-101.

Jarrow, Robert. "Heterogeneous Expectations, Restrictions on Short Sales, and Equilibrium Asset Prices," Journal of Finance, vol. 35, December 1980, 1105-1113.

Kaysen, C., and Turner, D. Antitrust Policy: An Economic and Legal Analysis, Cambridge, Massachusetts: Harvard University Press, 1959.

Kendall, M.G., and Babington-Smith, B. "The Problem Of m Rankings, The Annals of Mathematical Statistics, vol. 10, 1939, 275-287.

Keynes, John Maynard. The General Theory of Employment, Interest, and Money, (Originally London, 1935) reprinted New York: Harcourt, Brace and World, Inc., 1964.

Klepczynski, Carl H. "Analysis of Forecasting Ability of Investment Services and Simplistic Models," unpublished working paper, The University of Pennsylvania, 1971.

Kolbe, A. Lawrence, and Read, James A., with George R. Hall. The Cost of Capital: Estimating the Rate of Return for Public Utilities, Cambridge, Massachusetts: The MIT Press, 1984.

Lindenberg, Eric and Vinson, Steve R. Testimony in Federal Communications Commission Docket 84-800, Investigation of the Authorized Rate of Return for the Interstate Services of AT&T and Local Exchange Carriers, Washington, D.C.: Federal Communications Commission, 1985.

Linke, Charles M. "Estimating Growth Expectations for AT&T: A Survey Approach," in Earnings Regulation Under Inflation, Edited by J. Rhodes Foster and Stevan R. Holmberg, Washington, D.C.: Institute of Study of Regulation, 1982.

Linter, John. "The Aggregation of Investors' Diverse Judgements and Preferences in Purely Competitive Securities Markets," Journal of Financial and Quantitative Analysis, vol. 4, 347-400.

Litzenberger, Robert. Testimony in Federal Communications Commission Docket 84-800, Investigation of the Authorized Rate of Return for the Interstate Services of AT&T and Local Exchange Carriers, Washington, D.C.: Federal Communications Commission, 1985.

Litzenberger, Robert and Ronn, Ehud I. "A Utility Based Model of Common Stock Price Movements," Journal of Finance, vol. 41, March 1986, 67-92.

Lloyd-Davies, Peter, and Canes, Michael. "Stock Prices and the Publication of Second-Hand Information." Journal of Business, vol. 51, no.1, 1978, 43-56.

Lorek, K.S., McDonald, C.L., and Patz, D. "A Comparative Examination of Management Forecasts and Box-Jenkins Forecasts of Earnings," The Accounting Review, vol. 51, 1976, 310-321.

Malkiel, Burton G., and Cragg, John G., "Expectations and the Structure of Share Prices," American Economic Review, vol. 60, 1970, 601-617.

Marston, Felicia, Harris, Robert, and Crawford, Peter. "Risk and Return in Equity Markets: Evidence Using Financial Analysts' Forecasts," unpublished working paper, University of North Carolina at Chapel Hill, 1986.

Mayshar, Joram. "On Divergence of Opinion and Imperfections in Capital Markets," American Economic Review, vol. 73, March 1983, 114-128.

McDonald, Charles L. "An Empirical Examination of the Reliability of Published Predictions of Future Earnings," The Accounting Review, July 1973, 502-510.

McEnally, Richard W. "An Investigation of the Extrapolative Determinants of Short-Run Earnings Expectations," Journal of Financial and Quantitative Analysis, vol. 6, March 1971, 687-706.

Miller, Edward M. "Risk, Uncertainty, and Divergence of Opinion," Journal of Finance, vol. 32, September 1977, 1151-1168.

Morin, Roger A. Utilities' Cost of Capital, Arlington, Virginia: Public Utilities Reports, Inc., 1984.

Muth, John F. "Rational Expectations and the Theory of Price Movements," Econometrica, vol. 63, July 1964, 315-355.

Nelson, Charles R. "Rational Expectations and the Predictive Efficiency of Economic Models," Journal of Business, vol. 48, no. 3, July 1975, 331-343.

Peterson, David, and Peterson, Pamela. "The Effect of Changing Expectations upon Stock Returns," Journal of Financial and Quantitative Analysis, vol. 17, no. 5, December 1982, 799-813.

Pratt, John. "Risk Aversion in the Small and in the Large," Econometrica, vol. 32, January 1964, 122-136.

Raiffa, Howard, and Schlaifer, Robert. Applied Statistical Decision Theory, Cambridge, Massachusetts: Graduate School of Business Administration, Harvard University, 1961.

Richards, R. Malcolm. "Analysts' Performance and the Accuracy of Corporate Earnings Forecasts," Journal of Business, vol. 50, no. 4, 350-357.

Rubenstein, Mark, "Securities Market Efficiency in An Arrow-Debreu Economy," American Economic Review, vol. 65, December 1975, 812-824.

Ruland, William. "The Accuracy of Forecasts by Management and by Financial Analysts," The Accounting Review, vol. 53, no. 2, April 1978, 439-447.

Shannon, C.E. "A Mathematical Theory of Communication," Bell System Technical Journal, vol. 27, 1948, 379-423.

Sharkey, William W. The Theory of Natural Monopoly, Cambridge: Cambridge University Press, 1982.

Stanley, Kenneth L., Lewellen, Wilbur G., and Schlarbaum, Gary G. "Further Evidence on the Value of Professional Investment Research," The Journal of Financial Research, vol. 4, no. 1, Spring 1981, 1-9.

Stewart, Samuel S. "Research Report on Corporate Forecasts," Financial Analysts' Journal, vol. 29, 1973, 77-85.

Theil, Henri. Economic Forecasts and Policy, Second Edition, Amsterdam, The Netherlands: North Holland Publishing Company, 1962.

Theil, Henri. Principles of Econometrics, New York: John Wiley and Sons, 1971.

Timme, Stephen G., and Eisemann, Peter C. "An Evaluation of Alternative Measures of Analysts' Forecasts of Growth in the Constant Growth Model," unpublished working paper, University of Georgia, 1986.

Varian, Hal. "Divergence of Opinion in Complete Markets: A Note," Journal of Finance, vol. 40, March 1985, 309-317.

Verrecchia, Robert E. "A Proof of the Existence of Consensus Beliefs'," Journal of Finance, vol. 34, September 1979, 957-963.

Verrecchia, Robert E. "Consensus Beliefs, Informational Acquisition, and Market Information Efficiency," American Economic Review, vol. 70, no. 5, December 1980, 874-884.

Wilcoxon, F. "Individual Comparisons By Ranking Methods," Biometrics, vol. 1, 1945, 80-83.

Williams, John Burr. The Theory of Investment Value, (Originally Chicago, 1938) reprinted Amsterdam: North Holland Publishing, 1956.

Williams, Joseph T. "Capital Asset Prices with Heterogeneous Beliefs," Journal of Financial Economics, vol. 5, 1977, 219-239.

Willig, Robert D., and Bailey, Elizabeth E. "Income Distribution Concerns in Regulatory Policymaking," in Studies in Public Regulation, Edited by Gary Fromm, Cambridge, Massachusetts: The MIT Press, 1983.

Zarnowitz, Victor. "On Functions, Quality, and Timeliness of Economic Information," Journal of Business, vol. 55, no. 1, 1982, 87-119.

APPENDIX 1

SECURITY ANALYSTS CONTRIBUTING ESTIMATES TO THE IBES DATA BASE

Adams, Harkness and Company
Advest
Alexander Brown & Son
Argus Research
Robert Baird & Company
J.C. Bradford & Company
Bear Stearns
Sanford Berstein & Company
Birr Wilson

Blunt Ellis & Logan
Boettcher & Company
Butcher & Singer
Cable, Howse & Ragland
Chicago Corporation
Cowen & Company
Dain Bosworth
D.A. Davidson & Company

Dean Witter Reynolds
Dillon Read
Dominion Securities
Donaldson Lufkin Jennrette
Drexel Burnham
Duff & Phelps
Eberstat Fleming
Equitable Securities
A. G. Edwards

Fahnestock & Company
Ferris Securities
First Boston
Foster & Marshall
Fourteen Research
Fox Pitt Kelton

Merrill Lynch
Montgomery Securities
Morgan Nugent
Morgan Stanley
Moseley Hallgar & Company
Nomura Securities
Ohio Company
Oppenheimer
Paine Webber Mitchell Hutchins

Pershing & Company
Piper Jeffery & Company
Prescott Ball
Prudential Bache
Raymond James & Company
Rauscher Pierce & Company
Robertson, Coleman & Company

Robinson Humphrey
L.F. Rothschild
Salomon Brothers
Scott & Stingman
Shearson Lehman
Smith Barney
Standard & Poors
Stieffel Nicolaus & Company

Sutro & Company
Swergold Chefitz & Company
Tucker Anthony
Underwood Neuhause & Company

Furman Selz & Mage
Goldman Sachs
Hambrecht & Company
Howard Weil & Company
E. F. Hutton
Interstate Securities
Janney Montgomery & Company
John Morgan Rose
Johnson Lane
Kidder Peabody
Keefe, Bruyette & Company
C.J. Lawrence
Mabon Nugent
McDonald & Company
S.G. Warburg & Rowe
Wetheim & Company
Wessels Arnold & Company
Wheat First Securities
Value Line

APPENDIX 2

INDUSTRY CATEGORIES AND ASSOCIATED SIC CODES

Industry	SIC Code Range
AGRICULTURE AND MINING	0100 - 1399
BANKING	6000 - 6099
CHEMICALS AND DRUGS	2800 - 2899
COMMUNICATIONS	4830 - 4899
CONSTRUCTION	1500 - 1799
CONSUMER GOODS	3900 - 3999
ELECTRONICS	3600 - 3699
FOOD AND BEVERAGE	2000 - 2099
FOREST PRODUCTS	2400 - 2699
MACHINERY	3500 - 3599
METALS	3300 - 3499
NON-BANK FINANCE	6100 - 6499
OFFICE EQUIPMENT	3800 - 3899
PETROLEUM REFINING	2900 - 2999
PUBLISHING AND PRINT	2700 - 2799
REAL ESTATE	6500 - 6799
RESTAURANTS AND SPECIALTY TRADE	5800 - 5999
RETAIL TRADE	5200 - 5799
RUBBER, PLASTIC, AND LEATHER PRODUCTS	2900 - 3199
SERVICE	7000 - 7999
SOCIAL SERVICES	8000 - 8999
STONE,CLAY,GLASS, AND CONCRETE PRODUCTS	3200 - 3299
TEXTILES	2200 - 2399
TRANSPORTATION	4000 - 4799
TRANSPORTATION EQUIPMENT	3700 - 3799
UTILITIES	4811, 4900 - 4999
WHOLESALE TRADE	5000 - 5199

APPENDIX 3

FORECASTS BY HISTORICAL METHODS: PEARSON CORRELATION COEFFICIENTS

Agriculture and Mining

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.75												
HD3	.62	.64											
HD4	.96	.64	.59										
HE1	.68	.52	.59	.53									
HE2	.43	.39	.33	.27	.73								
HE3	.49	.39	.49	.33	.58	.61							
HE4	.81	.69	.63	.44	.89	.51	.44						
HB1	-.20	-.32	-.30	-.15	-.23	-.24	-.01	-.11					
HB2	-.42	-.32	-.23	-.33	-.30	.31	-.02	-.21	.78				
HB3	.12	.13	.18	.06	-.10	-.19	.12	.12	.45	.48			
HB4	-.07	-.28	-.03	-.10	-.16	-.18	-.12	-.04	.93	.66	.28		
H1	.56	.42	.32	.46	.66	.46	.27	.60	-.04	-.08	.00	-.06	
H2	.58	.51	.42	.35	.77	.56	.46	.70	-.25	-.31	-.25	-.22	.86

Banking

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.80												
HD3	.24	.58											
HD4	.95	.77	-.02										
HE1	.62	.63	.41	.55									
HE2	-.25	.20	.54	-.27	.38								
HE3	-.03	.10	.42	-.12	.34	.41							
HE4	.73	.74	.46	.70	.86	.31	.11						
HB1	.01	.16	.03	.03	.18	.33	.08	.21					
HB2	-.11	-.20	-.12	-.10	-.25	-.12	-.11	-.07	.40				
HB3	-.13	-.06	-.02	-.14	-.24	-.26	-.06	-.11	.22	.54			
HB4	.00	.12	.06	.03	.22	.40	.16	.19	.83	.30	-.13		
H1	.22	.44	.49	.12	.42	.22	.25	.37	-.06	-.29	-.22	-.02	
H2	.17	.38	.54	.06	.47	.33	.42	.36	-.08	-.40	-.41	.05	.94

Chemicals and Drugs

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.71												
HD3	.14	.28											
HD4	.98	.72	.10										
HE1	.55	.57	.39	.56									
HE2	.09	.33	.40	.06	.70								
HE3	-.08	.11	.17	-.08	.31	.39							
HE4	.62	.67	.39	.65	.89	.53	.21						
HB1	-.08	-.02	-.27	-.08	-.09	-.01	-.14	-.12					
HB2	-.07	-.06	-.24	.01	-.08	-.06	-.03	-.06	.32				
HB3	-.07	-.06	-.02	.02	-.08	-.06	-.03	-.06	.32	.62			
HB4	.10	.08	-.10	.12	.16	.02	.04	.13	.90	.47	.14		
H1	.16	.32	.20	.19	.42	.36	.14	.46	.02	.07	-.05	.11	
H2	.06	.21	.30	.09	.50	.53	.41	.47	-.05	-.16	-.26	.04	.88

Communications

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.99												
HD3	.31	.88											
HD4	.99	.98	.33										
HE1	.35	.79	.14	.42									
HE2	.02	.73	-.46	.02	.77								
HE3	-.38	-.32	.11	-.35	.39	.37							
HE4	.32	.78	.95	.40	.67	-.33	.33						
HB1	.52	.53	.34	.57	-.22	-.50	-.57	.55					
HB2	.02	.22	.49	.05	-.19	-.60	-.73	.42	.62				
HB3	.36	-.86	-.00	.38	.00	-.19	.40	.09	-.25	-.05			
HB4	.41	.64	.48	.45	-.18	-.51	-.59	.64	.94	.72	-.34		
H1	-.82	-.61	-.18	-.80	-.10	-.17	.72	-.03	-.07	-.11	.24	-.19	
H2	-.14	-.26	.05	-.06	.14	.04	.80	.19	-.02	-.25	.19	-.16	.98

Construction

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.94												
HD3	-.61	.57											
HD4	.98	.81	.21										
HE1	.66	-.14	.23	.43									
HE2	-.24	-.01	.55	-.24	.65								
HE3	.36	.22	.17	.03	-.24	.49							
HE4	.92	-.22	-.11	.52	.92	.42	-.39						
HB1	-.16	-.38	-.60	-.12	-.46	-.64	.18	-.30					
HB2	-.23	-.56	-.69	-.36	-.38	-.53	-.02	-.19	.93				
HB3	.44	-.32	.22	-.34	.78	.93	.39	.56	-.64	-.43			
HB4	-.18	-.00	-.37	-.10	-.62	-.60	.36	-.51	.93	.82	-.70		
H1	.76	.30	.14	.63	.57	.67	.37	.47	-.52	-.59	.92	-.55	
H2	.39	.27	.33	.31	.33	.83	.63	.11	-.61	-.70	.96	-.65	.85

Consumer Goods

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.67												
HD3	.40	.09											
HD4	.98	.52	-.09										
HE1	.68	.10	.57	.56									
HE2	.54	.22	.58	.25	.52								
HE3	.27	.31	-.11	.17	.16	.13							
HE4	.78	.32	.45	.63	.83	.67	.02						
HB1	.05	.09	-.19	-.15	-.28	-.01	.05	-.11					
HB2	-.13	-.15	-.35	-.10	-.23	-.10	.16	-.13	.69				
HB3	-.21	-.17	-.39	-.13	-.26	.10	.03	-.11	.39	.51			
HB4	-.26	-.13	-.32	-.22	-.21	-.35	.08	-.32	.64	.64	.16		
H1	.40	.18	.23	.38	.33	.60	-.09	.57	-.36	-.21	.08	-.47	
H2	.49	.26	.36	.38	.53	.75	.21	.64	-.36	-.36	-.13	-.50	.87

Electronics

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.83												
HD3	.39	.59											
HD4	.98	.74	.28										
HE1	.81	.64	.32	.69									
HE2	.47	.53	.42	.28	.59								
HE3	.21	.34	.18	.24	.63	.50							
HE4	.76	.65	.45	.69	.88	.58	.54						
HB1	-.00	-.10	-.10	.06	.15	.05	.10	.13					
HB2	-.07	-.27	-.07	-.03	-.21	-.10	-.23	-.16	.57				
HB3	-.21	-.35	-.05	-.15	-.26	-.22	-.18	-.21	.33	.56			
HB4	.08	-.04	.00	.11	.03	.02	-.03	.18	.74	.66	.25		
H1	.41	.21	.38	.36	.44	.27	.26	-.19	-.05	-.05	-.00	-.04	
H2	.40	.37	.24	.35	.47	.52	.48	.27	-.21	-.15	-.21	-.12	.93

Food and Beverage

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.67												
HD3	.22	.48											
HD4	.93	.59	.28										
HE1	.48	.36	.31	.47									
HE2	.14	.20	.54	-.07	.57								
HE3	.10	-.09	-.00	.11	.59	.37							
HE4	.45	.55	.32	.50	.90	.28	.50						
HB1	-.14	.08	-.03	-.21	-.02	.21	.24	.08					
HB2	-.33	-.24	-.04	-.33	-.00	.29	.35	-.04	.69				
HB3	-.02	-.20	-.03	-.05	-.15	.05	.13	-.10	.41	.49			
HB4	-.21	.07	-.14	-.26	-.11	.08	.11	.06	.90	.50	.19		
H1	.11	.03	-.03	.29	.31	.06	.14	.37	-.09	-.13	-.00	-.09	
H2	.11	-.02	-.04	.22	.44	.18	.31	.41	-.08	-.09	-.12	-.09	.96

Forest Products

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.63												
HD3	.43	.61											
HD4	.97	.71	.60										
HE1	.19	.19	.13	.16									
HE2	.04	.10	.24	-.13	.72								
HE3	.21	.07	.37	.13	.48	.65							
HE4	.37	.54	.49	.41	.81	.69	.49						
HB1	-.01	-.03	-.37	.18	-.02	-.13	-.25	.04					
HB2	-.26	-.42	-.24	-.12	-.21	-.12	-.25	-.11	.52				
HB3	-.21	-.22	-.11	-.27	-.09	.11	-.01	-.04	.01	.18			
HB4	.06	.09	-.21	.21	-.10	-.14	-.21	.06	.09	.58	-.17		
H1	.16	.04	.48	.00	.03	.44	.32	.39	-.07	-.00	.30	-.04	
H2	.16	-.02	.38	-.05	.41	.75	.67	.51	-.10	-.21	.15	-.10	.85

Machinery

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.72												
HD3	.55	.68											
HD4	.97	.64	.40										
HE1	.62	.61	.75	.55									
HE2	.30	.51	.82	.26	.80								
HE3	.43	.45	.53	.34	.50	.51							
HE4	.60	.66	.47	.61	.92	.69	.40						
HB1	.20	.07	-.24	.16	-.00	-.30	-.22	-.02					
HB2	.17	-.09	-.31	.03	-.32	-.52	-.50	-.27	.78				
HB3	.16	-.17	-.15	-.20	-.25	-.09	-.17	-.21	.02	.33			
HB4	.07	.10	-.15	.10	.05	-.21	-.22	.02	.94	.64	-.10		
H1	.58	.43	.57	.28	.73	.63	.28	.73	.03	-.22	.03	.07	
H2	.53	.40	.65	.37	.82	.71	.62	.73	-.03	-.34	-.00	.04	.92

Metals

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.27												
HD3	.33	.42											
HD4	.95	.34	.36										
HE1	.63	.34	.47	.59									
HE2	.16	.14	.22	.10	.66								
HE3	.16	-.28	.09	.07	.28	.22							
HE4	.73	.53	.55	.75	.85	.40	-.03						
HB1	.04	-.14	-.33	-.06	-.20	-.03	.00	-.19					
HB2	-.00	-.09	-.33	-.04	-.26	-.20	.01	-.22	.74				
HB3	.20	-.00	.05	.11	.04	-.01	-.07	-.08	.35	.45			
HB4	-.00	-.13	-.30	-.08	-.25	-.07	.10	-.16	.89	.62	-.04		
H1	.48	.14	.38	.35	.68	.28	.04	.57	-.19	-.32	-.08	-.20	
H2	.38	.03	.37	.29	.71	.50	.14	.56	-.24	-.37	-.20	-.22	.92

Non-Bank Finance

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.64												
HD3	.37	.52											
HD4	.74	.70	.33										
HE1	.63	.49	.27	.48									
HE2	.27	.38	.35	.31	.73								
HE3	-.23	.01	.04	-.16	.15	.24							
HE4	.51	.72	.21	.49	.88	.74	.04						
HB1	-.19	-.29	-.09	-.28	.14	.09	.08	-.09					
HB2	-.33	-.24	.21	-.45	-.05	-.01	.13	-.12	.54				
HB3	-.03	.35	.59	-.04	.14	.31	.36	.29	.29	.39			
HB4	-.25	-.29	-.05	-.22	.12	.18	.18	-.09	.82	.66	.29		
H1	.19	.15	.15	.30	.17	.27	-.28	.26	-.05	-.05	-.06	.11	
H2	.19	.16	.15	.31	.27	.41	-.14	.04	.32	.29	.33	.50	.93

Office Equipment

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.65												
HD3	-.37	-.94											
HE1	.69	.75	-.56	.79									
HE2	.24	-.02	.10	.24	-.30								
HE3	-.53	-.98	.98	-.53	-.65	.06							
HE4	.42	.49	-.33	.66	.75	.14	-.39						
HB1	-.42	.37	-.65	-.43	.01	-.49	-.51	-.1					
HB2	-.72	-.54	.33	-.81	-.46	-.70	.44	-.73	.43				
HB3	-.14	-.20	.11	-.40	-.40	-.38	.12	-.94	.24	.66			
HB4	-.77	-.16	-.12	-.72	-.17	-.71	.03	-.25	.80	.77	.21		
H1	.60	-.14	.47	.61	.35	.11	.30	.22	.89	-.36	-.17	-.69	
H2	.24	-.49	.75	.30	.05	.23	.63	.21	.93	-.24	-.31	-.55	.89

Petroleum Refining

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.52												
HD3	.34	.17											
HD4	.96	.50	.23										
HE1	.49	.51	.46	.43									
HE2	.00	.23	.33	-.27	.18								
HE3	.11	.05	.27	.19	.17	-.02							
HE4	.58	.55	.27	.55	.93	-.02	.06						
HB1	-.17	-.01	-.09	-.16	.37	-.27	-.59	.46					
HB2	-.16	-.06	.06	-.18	.27	-.04	-.61	.37	.83				
HB3	.18	-.02	.15	.13	.15	.12	.10	.06	.02	.16			
HB4	-.21	.03	.28	-.11	.25	.16	.32	.51	.95	.51	.11		
H1	.31	.41	-.02	.19	.24	.36	.04	.55	.12	-.06	.15	.07	
H2	.28	.44	-.00	.17	.27	.45	.27	.61	.20	-.15	-.04	.22	.94

Publishing and Printing

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.81												
HD3	.50	.57											
HD4	.99	.70	.23										
HE1	.58	.83	.55	.50									
HE2	.00	.47	.34	.06	.51								
HE3	-.13	.08	.03	-.10	.23	.44							
HE4	.75	.93	.64	.58	.93	.45	.16						
HB1	-.18	.02	.11	-.07	.18	.10	.04	.49					
HB2	-.39	-.15	-.03	-.31	-.04	.00	-.23	.07	.65				
HB3	-.08	.02	-.32	-.02	-.03	-.08	-.37	.04	.39	.68			
HB4	-.21	.03	.28	-.11	.25	.16	.32	.51	.95	.51	.11		
H1	.31	.41	-.02	.17	.24	.36	.04	.55	.12	-.06	.15	.07	
H2	.28	.44	.00	.17	.27	.45	.27	.61	.20	-.15	-.04	.22	.94

Real Estate

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.76												
HD3	.01	.18											
HD4	.96	.63	-.04										
HE1	.65	.60	.05	.49									
HE2	.50	.35	.18	.34	.56								
HE3	-.23	-.04	.03	-.30	.12	.24							
HE4	.78	.68	.14	.72	.78	.44	-.31						
HB1	.32	.31	-.15	.44	.25	-.37	-.14	.28					
HB2	.72	.49	-.38	.67	.36	.15	.09	.16	.56				
HB3	-.59	-.07	.12	-.56	-.33	-.16	-.30	.00	-.10	-.26			
HB4	.37	.31	-.12	.49	.34	-.33	-.08	.38	.97	.51	-.19		
H1	.00	-.24	.45	.04	.08	-.00	-.53	.12	-.23	-.38	.16	-.22	
H2	.08	-.13	.48	.10	.21	.19	-.37	.23	-.20	-.32	.07	-.17	.97

Restaurants and Specialty Trade

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.72												
HD3	.58	.74											
HD4	.99	.75	.47										
HE1	.42	.65	.57	.63									
HE2	.39	.42	.48	.46	.78								
HE3	.27	-.37	-.60	.14	.31	.66							
HE4	.46	.68	.60	.66	.87	.62	.45						
HB1	-.22	.19	.19	-.03	.38	.29	.03	.00					
HB2	-.25	-.08	.15	-.23	.26	.33	.08	-.01	.02				
HB3	-.24	-.28	.14	-.07	.29	.32	-.02	-.12	.48	.49			
HB4	-.23	.28	.14	-.13	.31	.28	.05	.05	.95	-.09	.25		
H1	-.00	-.11	-.41	.17	.19	.05	-.40	-.40	.04	.10	-.06	.00	
H2	-.17	-.36	-.64	-.07	.00	-.03	-.19	-.49	-.07	-.00	-.15	-.07	.87

Retail Trade

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.78												
HD3	.54	.35											
HD4	.94	.70	.53										
HE1	.45	.31	.41	.55									
HE2	.17	-.04	.55	.18	.66								
HE3	.00	.09	.11	.06	.54	.62							
HE4	.51	.57	.24	.62	.82	.29	.32						
HB1	.31	.39	.24	.29	.53	.31	.10	.41					
HB2	-.15	.17	.04	-.02	.43	.19	.09	.18	.83				
HB3	-.22	.14	-.08	-.14	.30	.30	.25	.28	.42	.52			
HB4	.25	.29	.18	.23	.19	.20	.14	.31	.94	.60	.22		
H1	.04	.02	-.17	.11	-.40	-.26	-.26	.36	-.58	-.65	.23	.01	
H2	.03	-.26	.25	-.03	.21	.57	.02	.11	.14	.01	.25	.07	.93

Rubber, Plastic and Leather Products

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.63												
HD3	.50	.66											
HD4	.90	.74	.34										
HE1	.40	.77	.63	.60									
HE2	.39	.46	.55	.42	.75								
HE3	.56	.02	.47	-.06	.18	.50							
HE4	.49	.79	.58	.69	.96	.73	.10						
HB1	.38	.29	.02	.55	.12	.06	.03	.11					
HB2	.28	.16	-.12	.41	-.07	-.02	.17	-.07	.86				
HB3	-.00	-.14	-.10	.11	-.15	-.12	-.10	-.13	.63	.52			
HB4	.41	.39	.01	.61	.16	.09	.08	.17	.94	.89	.43		
H1	.31	.50	.49	.35	.69	.75	.17	.68	-.10	-.35	-.20	-.14	
H2	.42	.38	.51	.26	.62	.81	.39	.58	-.13	-.30	-.35	-.11	.96

Service

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.74												
HD3	.49	.43											
HD4	.97	.74	.49										
HE1	.55	.20	.50	.67									
HE2	.33	.02	.44	.45	.69								
HE3	-.03	.23	.68	.16	.37	.56							
HE4	.59	.52	.43	.71	.87	.59	.10						
HB1	-.03	-.15	-.05	.05	.46	-.11	-.10	.06					
HB2	.01	-.07	-.24	.08	.32	.07	-.41	.16	.69				
HB3	-.06	-.13	-.52	-.33	-.03	-.02	-.39	.14	.02	.31			
HB4	-.09	-.07	.06	.02	-.10	-.12	-.17	-.04	.93	.62	-.00		
H1	.04	.12	.04	.14	-.21	.51	-.08	.53	-.22	-.14	.29	.01	
H2	.06	.18	.21	.36	.30	.62	.26	.42	.05	-.07	.01	.01	.73

Social Services

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.12												
HD3	.93	.50											
HD4	.96	.29	.76										
HE1	.89	.04	.20	.87									
HE2	.83	.69	.79	.88	.47								
HE3	.84	.41	.85	.84	.58	.94							
HE4	.95	.60	.59	.94	.85	.62	.55						
HB1	.77	-.13	-.09	.10	.32	-.00	.08	.18					
HB2	.82	-.64	.25	.03	.12	.06	.34	.10	.46				
HB3	.72	-.11	.07	.79	.30	.26	.47	.21	.12	.19			
HB4	.62	-.02	.00	-.11	.33	.03	.13	.27	.92	.49	-.03		
H1	.23	.07	-.01	.16	.44	.00	-.01	.08	.13	-.31	-.04	.01	
H2	.17	.17	.13	.09	.48	.11	.15	.09	.05	-.34	-.20	.02	.94

Stone, Clay, Glass amd Concrete Products

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.60												
HD3	.32	.52											
HD4	.95	.36	.25										
HE1	.36	.42	.55	.76									
HE2	.02	.22	.89	.20	.49								
HE3	.38	.14	.75	.37	.52	.65							
HE4	.26	.60	.25	.54	.83	.47	.13						
HB1	.10	-.17	-.29	-.16	.38	-.23	-.32	.25					
HB2	-.24	-.07	.14	-.1	.12	.21	-.14	.27	.31				
HB3	.44	.21	.48	-.70	.03	.41	.23	.04	.27	.11			
HB4	-.14	-.28	-.44	-.24	.35	-.31	-.46	.24	.97	.35	.21		
H1	.19	.39	.63	.39	.45	.75	.22	.58	-.18	-.01	.27	-.25	
H2	.14	.27	.79	.58	.79	.67	.50	.62	.24	-.04	.39	.18	.79

Textiles

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.79												
HD3	.73	.80											
HD4	.98	.86	.67										
HE1	.70	.69	.56	.76									
HE2	.58	.82	.60	.74	.66								
HE3	.20	-.20	-.06	-.06	-.12	.25							
HE4	.58	.81	.70	.75	.75	.49	-.49						
HB1	.04	.24	.40	.17	-.21	-.17	.10	.13					
HB2	-.10	.03	.16	-.07	-.38	-.22	.17	-.02	.62				
HB3	-.31	-.14	-.03	-.27	-.50	-.15	.27	-.27	.58	.80			
HB4	.06	.29	.38	.25	-.14	-.21	-.03	.18	.95	.44	.40		
H1	.50	.57	.58	.68	.63	.42	-.04	.53	-.23	.27	-.18	-.28	
H2	.35	.27	-.00	.47	.46	.48	.20	.04	-.49	-.07	-.40	-.47	.94

Transportation

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.73												
HD3	.09	.55											
HD4	.97	.70	.13										
HE1	.29	.50	.34	.42									
HE2	-.26	.44	.49	-.18	.62								
HE3	-.06	.00	.31	.11	.31	.52							
HE4	.62	.81	.36	.63	.76	.09	-.06						
HB1	.26	.40	-.18	.22	-.01	-.07	-.03	-.02					
HB2	.16	.20	-.34	.09	-.18	-.18	-.01	-.12	.67				
HB3	.10	-.04	-.08	-.13	-.48	-.17	-.45	-.32	.27	.45			
HB4	.20	.41	-.21	.25	-.03	-.05	-.01	-.02	.83	.71	.06		
H1	.10	-.03	.14	.29	.07	.23	.20	.22	-.05	.05	.05	.11	
H2	-.04	.01	.16	.25	.05	.55	.37	.05	-.02	-.00	.03	.08	.94

Transportation Equipment

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.87												
HD3	.44	.63											
HD4	.97	.82	.38										
HE1	.74	.67	.44	.65									
HE2	.50	.71	.52	.39	.84								
HE3	-.13	.25	.45	-.17	.05	.32							
HE4	.25	.34	.37	.89	.71	.06	.54						
HB1	.21	-.07	.15	.06	.00	.42	-.11	.50					
HB2	.24	.35	-.10	.25	.09	.11	.15	.25	.54				
HB3	.35	.43	-.02	.39	.15	.22	.01	.17	.31	.50			
HB4	.10	.17	-.06	.01	.07	.06	.42	-.09	.89	.56	.19		
H1	.10	.47	-.03	.15	.73	.76	-.04	.71	-.10	.16	.32	.10	
H2	.09	.48	.34	.12	.71	.70	.21	.53	.12	.34	.27	.92	.10

Utilities

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.76												
HD3	.53	.46											
HD4	.98	.71	.48										
HE1	.64	.66	.57	.68									
HE2	.26	.36	.44	.28	.67								
HE3	.16	.18	.11	.10	.32	.48							
HE4	.63	.71	.46	.63	.94	.59	.20						
HB1	.05	-.01	.11	.02	.14	.05	-.12	.18					
HB2	-.02	-.13	.08	.00	.00	.04	-.23	.04	.71				
HB3	.20	.03	.08	.21	.21	.14	.10	.16	.42	.52			
HB4	.00	.06	.12	-.05	.15	.05	-.09	.23	.93	.67	.30		
H1	.40	.42	.44	.45	.67	.44	.11	.65	.07	-.09	.12	.04	
H2	.37	.41	.47	.40	.71	.53	.29	.65	.02	-.15	.04	.02	.96

Wholesale Trade

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1
HD2	.30												
HD3	.16	.76											
HD4	.97	.41	.18										
HE1	.65	.06	.29	.58									
HE2	.19	.16	.43	.27	.80								
HE3	.20	.13	.04	.36	.38	.45							
HE4	.47	.46	.43	.57	.84	.71	.41						
HB1	-.17	.23	.00	-.00	-.00	-.05	-.21	-.10					
HB2	.16	.10	-.20	.03	.24	.09	-.14	.02	.54				
HB3	-.19	.04	-.23	-.10	-.05	-.29	-.21	-.26	.46	.66			
HB4	-.18	.09	.12	-.04	-.11	-.05	-.16	-.05	.89	.31	.16		
H1	.55	.04	.08	.38	.61	.34	.13	.36	.14	.37	.12	.07	
H2	.29	-.05	.09	.34	.63	.50	.38	.45	.08	-.03	-.15	.07	.79

APPENDIX 4

FORECASTS BY HISTORICAL METHODS AND IBES FORECASTS: PAIRWISE COMPARISONS OF FORECAST AGREEMENT. COMPUTED VALUES OF FRIEDMAN STATISTIC

AGRICULTURE AND MINING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	1.33	0.00	0.63	0.95	1.17	2.93	0.58	3.78	4.42	2.66	3.93	1.86	2.22
HD2	1.33	0.00	1.33	1.97	2.29	0.16	1.59	1.91	2.45	3.09	1.33	2.69	0.53	0.98
HD3	0.00	1.33	0.00	0.63	0.95	1.17	2.93	0.58	3.78	4.42	2.66	3.98	1.86	2.26
HD4	0.63	1.97	0.63	0.00	0.31	1.81	3.57	0.05	4.42	5.06	3.30	4.66	2.50	2.95
HE1	0.95	2.29	0.95	0.31	0.00	2.13	3.89	0.37	4.74	5.38	3.62	5.09	2.82	3.38
HE2	1.17	0.16	1.17	1.81	2.13	0.00	1.75	1.75	2.61	3.25	1.49	2.82	0.69	1.11
HE3	2.93	1.59	2.93	3.57	3.89	1.75	0.00	3.51	0.85	1.49	0.26	1.19	1.06	0.51
HE4	0.58	1.91	0.58	0.05	0.37	1.75	3.51	0.00	4.37	5.01	3.25	4.49	2.45	2.78
HB1	3.78	2.45	3.78	4.42	4.74	2.61	0.85	4.37	0.00	0.63	1.11	0.17	1.91	1.88
HB2	4.42	3.09	4.42	5.06	5.38	3.25	1.49	5.01	0.63	0.00	1.75	0.68	2.55	2.39
HB3	2.66	1.33	2.66	3.30	3.62	1.49	0.26	3.25	1.11	1.75	0.00	1.19	0.79	0.51
HB4	3.93	2.69	3.98	4.66	5.09	2.82	1.19	4.49	0.17	0.68	1.19	0.00	1.79	1.71
H1	1.86	0.53	1.86	2.50	2.82	0.69	1.06	2.45	1.91	2.55	0.79	1.79	0.00	0.08
H2	2.22	0.98	2.26	2.95	3.38	1.11	0.53	2.78	1.88	2.39	0.51	1.71	0.08	0.00

BANKING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	3.55	5.05	1.02	3.84	4.46	1.75	6.41	2.69	1.23	1.46	1.43	0.79	0.76
HD2	3.55	0.00	1.50	2.52	0.29	0.91	1.79	2.86	6.24	4.78	2.09	4.98	4.34	4.32
HD3	5.05	1.50	0.00	4.02	1.20	0.59	3.29	1.35	7.74	6.28	3.59	6.49	5.84	5.82
HD4	1.02	2.52	4.02	0.00	2.82	3.43	0.73	5.38	3.72	2.25	0.43	2.46	1.82	1.79
HE1	3.84	0.29	1.20	2.82	0.00	0.61	2.09	2.56	6.54	5.07	2.38	5.28	4.64	4.61
HE2	4.46	0.91	0.59	3.43	0.61	0.00	2.70	1.94	7.15	5.69	3.00	5.90	5.25	5.23
HE3	1.75	1.79	3.29	0.73	2.09	2.70	0.00	4.65	4.45	2.98	0.29	3.19	2.55	2.52
HE4	6.41	2.86	1.35	5.38	2.56	1.94	4.65	0.00	9.10	7.64	4.95	7.85	7.20	7.18
HB1	2.69	6.24	7.74	3.72	6.54	7.15	4.45	9.10	0.00	1.46	4.15	1.25	1.89	1.92
HB2	1.23	4.78	6.28	2.25	5.07	5.69	2.98	7.64	1.46	0.00	2.69	0.20	0.43	0.46
HB3	1.46	2.09	3.59	0.43	2.38	3.00	0.29	4.95	4.15	2.69	0.00	2.89	2.25	2.23
HB4	1.43	4.98	6.49	2.46	5.28	5.90	3.19	7.85	1.25	0.20	2.89	0.00	0.64	0.66
H1	0.79	4.34	5.84	1.82	4.64	5.25	2.55	7.20	1.89	0.43	2.25	0.64	0.00	0.02
H2	0.76	4.32	5.82	1.79	4.61	5.23	2.52	7.18	1.92	0.46	2.23	0.66	0.02	0.00

CHEMICALS AND DRUGS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.03	0.06	1.78	0.56	1.39	3.27	2.00	5.16	5.04	4.53	3.74	3.15	3.35
HD2	0.03	0.00	0.09	1.82	0.59	1.35	3.24	2.04	5.12	5.00	3.92	3.70	3.12	3.31
HD3	0.06	0.09	0.00	1.72	0.50	1.45	3.34	1.94	5.22	5.10	4.19	3.80	3.21	3.41
HD4	1.78	1.82	1.72	0.00	1.22	3.18	5.06	0.22	6.95	6.82	6.37	5.53	4.94	5.13
HE1	0.56	0.59	0.50	1.22	0.00	1.95	3.84	1.44	5.72	5.60	4.64	4.30	3.72	3.91
HE2	1.39	1.35	1.45	3.18	1.95	0.00	1.88	3.40	3.76	3.64	2.60	2.34	1.76	1.95
HE3	3.27	3.24	3.34	5.06	3.84	1.88	0.00	5.28	1.88	1.76	1.00	0.46	0.12	0.07
HE4	2.00	2.04	1.94	0.22	1.44	3.40	5.28	0.00	7.17	7.04	6.08	5.75	5.16	5.35
HB1	5.16	5.12	5.22	6.95	5.72	3.76	1.88	7.17	0.00	0.12	1.66	1.41	2.00	1.81
HB2	5.04	5.00	5.10	6.82	5.60	3.64	1.76	7.04	0.12	0.00	1.57	1.29	1.88	1.68
HB3	4.53	3.92	4.19	6.37	4.64	2.60	1.00	6.08	1.66	1.57	0.00	0.32	0.32	0.15
HB4	3.74	3.70	3.80	5.53	4.30	2.34	0.46	5.75	1.41	1.29	0.32	0.00	0.58	0.39
H1	3.15	3.12	3.21	4.94	3.72	1.76	0.12	5.16	2.00	1.88	0.32	0.58	0.00	0.19
H2	3.35	3.31	3.41	5.13	3.91	1.95	0.07	5.35	1.81	1.68	0.15	0.39	0.19	0.00

COMMUNICATIONS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.20	1.81	1.00	0.20	1.51	1.11	0.40	0.20	1.11	0.60	0.00	0.60	0.80
HD2	0.20	0.00	2.01	0.80	0.40	1.71	1.31	0.20	0.40	1.31	0.80	0.20	0.80	1.00
HD3	1.81	2.01	0.00	2.82	1.61	0.30	0.70	2.22	1.61	0.70	1.21	1.81	1.21	1.00
HD4	1.00	0.80	2.82	0.00	1.21	2.52	2.11	0.60	1.21	2.11	1.61	1.00	1.61	1.81
HE1	0.20	0.40	1.61	1.21	0.00	1.31	0.90	0.60	0.00	0.90	0.40	0.20	0.40	0.60
HE2	1.51	1.71	0.30	2.52	1.31	0.00	0.40	1.91	1.31	0.40	0.90	1.51	0.90	0.70
HE3	1.11	1.31	0.70	2.11	0.90	0.40	0.00	1.51	0.90	0.00	0.50	1.11	0.50	0.30
HE4	0.40	0.20	2.22	0.60	0.60	1.91	1.51	0.00	0.60	1.51	1.00	0.40	1.00	1.21
HB1	0.20	0.40	1.61	1.21	0.00	1.31	0.90	0.60	0.00	0.90	0.40	0.20	0.40	0.60
HB2	1.11	1.31	0.70	2.11	0.90	0.40	0.00	1.51	0.90	0.00	0.50	1.11	0.50	0.30
HB3	0.60	0.80	1.21	1.61	0.40	0.90	0.50	1.00	0.40	0.50	0.00	0.60	0.00	0.20
HB4	0.00	0.20	1.81	1.00	0.20	1.51	1.11	0.40	0.20	1.11	0.60	0.00	0.60	0.80
H1	0.60	0.80	1.21	1.61	0.40	0.90	0.50	1.00	0.40	0.50	0.00	0.60	0.00	0.20
H2	0.80	1.00	1.00	1.81	0.60	0.70	0.30	1.21	0.60	0.30	0.20	0.80	0.20	0.00

CONSTRUCTION

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.56	0.68	0.45	0.90	1.36	0.79	0.68	0.11	0.45	1.47	0.34	0.45	0.79
HD2	0.56	0.00	1.24	1.02	1.47	1.93	1.36	1.24	0.68	0.11	2.04	0.22	1.02	1.36
HD3	0.68	1.24	0.00	0.22	0.22	0.68	0.11	0.00	0.56	1.13	0.79	1.02	0.22	0.11
HD4	0.45	1.02	0.22	0.00	0.45	0.90	0.34	0.22	0.34	0.90	1.02	0.79	0.00	0.34
HE1	0.90	1.47	0.22	0.45	0.00	0.45	0.11	0.22	0.79	1.36	0.56	1.24	0.45	0.11
HE2	1.36	1.93	0.68	0.90	0.45	0.00	0.56	0.68	1.24	1.81	0.11	1.70	0.90	0.56
HE3	0.79	1.36	0.11	0.34	0.11	0.56	0.00	0.11	0.68	1.24	0.68	1.13	0.34	0.00
HE4	0.68	1.24	0.00	0.22	0.22	0.68	0.11	0.00	0.56	1.13	0.79	1.02	0.22	0.11
HB1	0.11	0.68	0.56	0.34	0.79	1.24	0.68	0.56	0.00	0.56	1.36	0.45	0.34	0.68
HB2	0.45	0.11	1.13	0.90	1.36	1.81	1.24	1.13	0.56	0.00	1.93	0.11	0.90	1.24
HB3	1.47	2.04	0.79	1.02	0.56	0.11	0.68	0.79	1.36	1.93	0.00	1.81	1.02	0.68
HB4	0.34	0.22	1.02	0.79	1.24	1.70	1.13	1.02	0.45	0.11	1.81	0.00	0.79	1.13
H1	0.45	1.02	0.22	0.00	0.45	0.90	0.34	0.22	0.34	0.90	1.02	0.79	0.00	0.34
H2	0.79	1.36	0.11	0.34	0.11	0.56	0.00	0.11	0.68	1.24	0.68	1.13	0.34	0.00

CONSUMER GOODS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.02	1.33	1.11	1.45	2.33	2.11	0.20	4.97	5.51	3.29	4.69	4.51	4.47
HD2	0.02	0.00	1.36	1.08	1.47	2.36	2.13	0.18	4.99	5.53	3.31	4.72	4.53	4.49
HD3	1.33	1.36	0.00	2.45	0.11	0.99	0.77	1.54	3.63	4.17	1.95	3.35	3.17	3.13
HD4	1.11	1.08	2.45	0.00	2.56	3.45	3.22	0.90	6.08	6.62	4.40	5.81	5.62	5.58
HE1	1.45	1.47	0.11	2.56	0.00	0.88	0.65	1.65	3.51	4.06	1.83	3.24	3.06	3.01
HE2	2.33	2.36	0.99	3.45	0.88	0.00	0.22	2.54	2.63	3.17	0.95	2.36	2.17	2.13
HE3	2.11	2.13	0.77	3.22	0.65	0.22	0.00	2.31	2.86	3.40	1.18	2.58	2.40	2.36
HE4	0.20	0.18	1.54	0.90	1.65	2.54	2.31	0.00	5.17	5.72	3.49	4.90	4.72	4.67
HB1	4.97	4.99	3.63	6.08	3.51	2.63	2.86	5.17	0.00	0.54	1.67	0.27	0.45	0.49
HB2	5.51	5.53	4.17	6.62	4.06	3.17	3.40	5.72	0.54	0.00	2.22	0.81	0.99	1.04
HB3	3.29	3.31	1.95	4.40	1.83	0.95	1.18	3.49	1.67	2.22	0.00	1.40	1.22	1.18
HB4	4.69	4.72	3.35	5.81	3.24	2.36	2.58	4.90	0.27	0.81	1.40	0.00	0.18	0.22
H1	4.51	4.53	3.17	5.62	3.06	2.17	2.40	4.72	0.45	0.99	1.22	0.18	0.00	0.04
H2	4.47	4.49	3.13	5.58	3.01	2.13	2.36	4.67	0.49	1.04	1.18	0.22	0.04	0.00

ELECTRONICS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.56	2.80	2.06	0.69	1.88	1.70	2.47	6.09	5.61	3.83	4.99	3.54	3.24
HD2	0.56	0.00	2.23	2.62	1.25	1.31	1.14	3.03	5.52	5.05	3.27	4.43	2.97	2.68
HD3	2.80	2.23	0.00	4.86	3.49	0.91	1.09	5.27	3.29	2.81	1.03	2.19	0.74	0.44
HD4	2.06	2.62	4.86	0.00	1.36	3.94	3.76	0.41	8.15	7.67	5.89	7.05	5.60	5.30
HE1	0.69	1.25	3.49	1.36	0.00	2.57	2.40	1.77	6.78	6.31	4.53	5.69	4.23	3.94
HE2	1.88	1.31	0.91	3.94	2.57	0.00	0.17	4.35	4.20	3.73	1.95	3.11	1.66	1.36
HE3	1.70	1.14	1.09	3.76	2.40	0.17	0.00	4.17	4.38	3.91	2.13	3.29	1.83	1.54
HE4	2.47	3.03	5.27	0.41	1.77	4.35	4.17	0.00	8.56	8.09	6.31	7.47	6.01	5.72
HB1	6.09	5.52	3.29	8.15	6.78	4.20	4.38	8.56	0.00	0.47	2.25	1.09	2.54	2.84
HB2	5.61	5.05	2.81	7.67	6.31	3.73	3.91	8.09	0.47	0.00	1.77	0.62	2.07	2.37
HB3	3.83	3.27	1.03	5.89	4.53	1.95	2.13	6.31	2.25	1.77	0.00	1.15	0.29	0.59
HB4	4.99	4.43	2.19	7.05	5.69	3.11	3.29	7.47	1.09	0.62	1.15	0.00	1.45	1.74
H1	3.54	2.97	0.74	5.60	4.23	1.66	1.83	6.01	2.54	2.07	0.29	1.45	0.00	0.29
H2	3.24	2.68	0.44	5.30	3.94	1.36	1.54	5.72	2.84	2.37	0.59	1.74	0.29	0.00

FOOD AND BEVERAGE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.73	3.34	2.28	3.31	1.23	2.71	5.21	5.07	4.19	0.70	4.12	4.15	3.31
HD2	0.73	0.00	2.60	1.55	2.57	0.49	1.97	4.47	5.81	4.93	1.44	4.86	4.89	4.05
HD3	3.34	2.60	0.00	1.05	0.03	2.11	0.63	1.86	8.41	7.53	4.05	7.46	7.50	6.65
HD4	2.28	1.55	1.05	0.00	1.02	1.05	0.42	2.92	7.36	6.48	2.99	6.41	6.44	5.60
HE1	3.31	2.57	0.03	1.02	0.00	2.07	0.59	1.90	8.38	7.50	4.01	7.43	7.46	6.62
HE2	1.23	0.49	2.11	1.05	2.07	0.00	1.47	3.98	6.30	5.42	1.93	5.35	5.39	4.54
HE3	2.71	1.97	0.63	0.42	0.59	1.47	0.00	2.50	7.78	6.90	3.41	6.83	6.86	6.02
HE4	5.21	4.47	1.86	2.92	1.90	3.98	2.50	0.00	10.2	9.40	5.91	9.33	9.37	8.52
HB1	5.07	5.81	8.41	7.36	8.38	6.30	7.78	10.2	0.00	0.88	4.36	0.95	0.91	1.76
HB2	4.19	4.93	7.53	6.48	7.50	5.42	6.90	9.40	0.88	0.00	3.48	0.07	0.03	0.88
HB3	0.70	1.44	4.05	2.99	4.01	1.93	3.41	5.91	4.36	3.48	0.00	3.41	3.45	2.60
HB4	4.12	4.86	7.46	6.41	7.43	5.35	6.83	9.33	0.95	0.07	3.41	0.00	0.03	0.81
H1	4.15	4.89	7.50	6.44	7.46	5.39	6.86	9.37	0.91	0.03	3.45	0.03	0.00	0.84
H2	3.31	4.05	6.65	5.60	6.62	4.54	6.02	8.52	1.76	0.88	2.60	0.81	0.84	0.00

FOREST PRODUCTS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	1.00	3.01	0.75	0.20	2.80	4.01	0.00	3.89	4.18	3.93	3.63	3.30	4.43
HD2	1.00	0.00	2.00	1.75	0.79	1.79	3.01	1.00	2.88	3.17	2.92	2.63	2.30	3.43
HD3	3.01	2.00	0.00	3.76	2.80	0.20	1.00	3.01	0.87	1.17	0.92	0.62	0.29	1.42
HD4	0.75	1.75	3.76	0.00	0.96	3.55	4.76	0.75	4.64	4.93	4.68	4.39	4.05	5.18
HE1	0.20	0.79	2.80	0.96	0.00	2.59	3.80	0.20	3.68	3.97	3.72	3.43	3.09	4.22
HE2	2.80	1.79	0.20	3.55	2.59	0.00	1.21	2.80	1.08	1.38	1.12	0.83	0.50	1.63
HE3	4.01	3.01	1.00	4.76	3.80	1.21	0.00	4.01	0.12	0.16	0.08	0.37	0.71	0.41
HE4	0.00	1.00	3.01	0.75	0.20	2.80	4.01	0.00	3.89	4.18	3.93	3.63	3.30	4.43
HB1	3.89	2.88	0.87	4.64	3.68	1.08	0.12	3.89	0.00	0.29	0.04	0.25	0.58	0.54
HB2	4.18	3.17	1.17	4.93	3.97	1.38	0.16	4.18	0.29	0.00	0.25	0.54	0.87	0.25
HB3	3.93	2.92	0.92	4.68	3.72	1.12	0.08	3.93	0.04	0.25	0.00	0.29	0.62	0.50
HB4	3.63	2.63	0.62	4.39	3.43	0.83	0.37	3.63	0.25	0.54	0.29	0.00	0.33	0.79
H1	3.30	2.30	0.29	4.05	3.09	0.50	0.71	3.30	0.58	0.87	0.62	0.33	0.00	1.12
H2	4.43	3.43	1.42	5.18	4.22	1.63	0.41	4.43	0.54	0.25	0.50	0.79	1.12	0.00

MACHINERY

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.26	2.03	1.71	0.60	2.49	3.55	2.35	5.28	4.01	4.29	4.92	1.28	2.24
HD2	0.26	0.00	1.76	1.97	0.86	2.22	3.28	2.61	5.01	3.74	4.02	4.66	1.02	1.97
HD3	2.03	1.76	0.00	3.74	2.63	0.45	1.51	4.38	3.25	1.97	2.26	2.89	0.74	0.21
HD4	1.71	1.97	3.74	0.00	1.11	4.20	5.26	0.63	6.99	5.72	6.00	6.64	3.00	3.95
HE1	0.60	0.86	2.63	1.11	0.00	3.09	4.15	1.74	5.88	4.61	4.89	5.53	1.89	2.84
HE2	2.49	2.22	0.45	4.20	3.09	0.00	1.06	4.84	2.79	1.51	1.80	2.43	1.20	0.24
HE3	3.55	3.28	1.51	5.26	4.15	1.06	0.00	5.90	1.73	0.45	0.74	1.37	2.26	1.30
HE4	2.35	2.61	4.38	0.63	1.74	4.84	5.90	0.00	7.63	6.36	6.64	7.27	3.63	4.59
HB1	5.28	5.01	3.25	6.99	5.88	2.79	1.73	7.63	0.00	1.27	0.98	0.35	3.99	3.03
HB2	4.01	3.74	1.97	5.72	4.61	1.51	0.45	6.36	1.27	0.00	0.28	0.91	2.72	1.76
HB3	4.29	4.02	2.26	6.00	4.89	1.80	0.74	6.64	0.98	0.28	0.00	0.63	3.00	2.04
HB4	4.92	4.66	2.89	6.64	5.53	2.43	1.37	7.27	0.35	0.91	0.63	0.00	3.63	2.68
H1	1.28	1.02	0.74	3.00	1.89	1.20	2.26	3.63	3.99	2.72	3.00	3.63	0.00	0.95
H2	2.24	1.97	0.21	3.95	2.84	0.24	1.30	4.59	3.03	1.76	2.04	2.68	0.95	0.00

METALS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.75	1.91	0.57	0.25	1.83	2.84	0.50	5.44	6.81	4.03	5.66	3.24	3.60
HD2	0.75	0.00	1.15	1.33	1.00	1.08	2.09	1.26	4.68	6.05	3.28	4.90	2.48	2.84
HD3	1.91	1.15	0.00	2.48	2.16	0.07	0.93	2.41	3.53	4.90	2.12	3.74	1.33	1.69
HD4	0.57	1.33	2.48	0.00	0.32	2.41	3.42	0.07	6.02	7.39	4.61	6.23	3.82	4.18
HE1	0.25	1.00	2.16	0.32	0.00	2.09	3.10	0.25	5.69	7.06	4.29	5.91	3.49	3.85
HE2	1.83	1.08	0.07	2.41	2.09	0.00	1.00	2.34	3.60	4.97	2.19	3.82	1.40	1.76
HE3	2.84	2.09	0.93	3.42	3.10	1.00	0.00	3.35	2.59	3.96	1.18	2.81	0.39	0.75
HE4	0.50	1.26	2.41	0.07	0.25	2.34	3.35	0.00	5.94	7.31	4.54	6.16	3.74	4.11
HB1	5.44	4.68	3.53	6.02	5.69	3.60	2.59	5.94	0.00	1.37	1.40	0.21	2.19	1.83
HB2	6.81	6.05	4.90	7.39	7.06	4.97	3.96	7.31	1.37	0.00	2.77	1.15	3.56	3.20
HB3	4.03	3.28	2.12	4.61	4.29	2.19	1.18	4.54	1.40	2.77	0.00	1.62	0.79	0.43
HB4	5.66	4.90	3.74	6.23	5.91	3.82	2.81	6.16	0.21	1.15	1.62	0.00	2.41	2.05
H1	3.24	2.48	1.33	3.82	3.49	1.40	0.39	3.74	2.19	3.56	0.79	2.41	0.00	0.36
H2	3.60	2.84	1.69	4.18	3.85	1.76	0.75	4.11	1.83	3.20	0.43	2.05	0.36	0.00

NON-BANK FINANCE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.68	1.68	2.92	2.26	5.67	6.11	1.37	7.04	5.37	5.48	4.63	5.63	6.74
HD2	0.68	0.00	2.37	2.24	2.94	6.35	6.80	0.68	7.72	6.06	6.17	5.31	6.31	7.43
HD3	1.68	2.37	0.00	4.61	0.57	3.98	4.42	3.05	5.35	3.68	3.79	2.94	3.94	5.05
HD4	2.92	2.24	4.61	0.00	5.18	8.59	9.04	1.55	9.97	8.30	8.41	7.56	8.56	9.67
HE1	2.26	2.94	0.57	5.18	0.00	3.41	3.85	3.63	4.78	3.11	3.22	2.37	3.37	4.48
HE2	5.67	6.35	3.98	8.59	3.41	0.00	0.44	7.04	1.37	0.29	0.18	1.03	0.03	1.07
HE3	6.11	6.80	4.42	9.04	3.85	0.44	0.00	7.48	0.92	0.74	0.63	1.48	0.48	0.63
HE4	1.37	0.68	3.05	1.55	3.63	7.04	7.48	0.00	8.41	6.74	6.85	6.00	7.00	8.11
HB1	7.04	7.72	5.35	9.97	4.78	1.37	0.92	8.41	0.00	1.66	1.55	2.40	1.40	0.29
HB2	5.37	6.06	3.68	8.30	3.11	0.29	0.74	6.74	1.66	0.00	0.11	0.74	0.25	1.37
HB3	5.48	6.17	3.79	8.41	3.22	0.18	0.63	6.85	1.55	0.11	0.00	0.85	0.14	1.26
HB4	4.63	5.31	2.94	7.56	2.37	1.03	1.48	6.00	2.40	0.74	0.85	0.00	1.00	2.11
H1	5.63	6.31	3.94	8.56	3.37	0.03	0.48	7.00	1.40	0.25	0.14	1.00	0.00	1.11
H2	6.74	7.43	5.05	9.67	4.48	1.07	0.63	8.11	0.29	1.37	1.26	2.11	1.11	0.00

OFFICE EQUIPMENT

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	1.14	0.93	0.82	0.41	2.48	3.73	0.31	3.94	3.73	2.90	3.31	2.69	2.69
HD2	1.14	0.00	0.20	1.97	0.72	1.34	2.59	1.45	2.80	2.59	1.76	2.17	1.55	1.55
HD3	0.93	0.20	0.00	1.76	0.51	1.55	2.80	1.24	3.00	2.80	1.97	2.38	1.76	1.76
HD4	0.82	1.97	1.76	0.00	1.24	3.31	4.56	0.51	4.77	4.56	3.73	4.14	3.52	3.52
HE1	0.41	0.72	0.51	1.24	0.00	2.07	3.31	0.72	3.52	3.31	2.48	2.90	2.28	2.28
HE2	2.48	1.34	1.55	3.31	2.07	0.00	1.24	2.80	1.45	1.24	0.41	0.82	0.20	0.20
HE3	3.73	2.59	2.80	4.56	3.31	1.24	0.00	4.04	0.20	0.00	0.82	0.41	1.03	1.03
HE4	0.31	1.45	1.24	0.51	0.72	2.80	4.04	0.00	4.25	4.04	3.21	3.63	3.00	3.00
HB1	3.94	2.80	3.00	4.77	3.52	1.45	0.20	4.25	0.00	0.20	1.03	0.62	1.24	1.24
HB2	3.73	2.59	2.80	4.56	3.31	1.24	0.00	4.04	0.20	0.00	0.82	0.41	1.03	1.03
HB3	2.90	1.76	1.97	3.73	2.48	0.41	0.82	3.21	1.03	0.82	0.00	0.41	0.20	0.20
HB4	3.31	2.17	2.38	4.14	2.90	0.82	0.41	3.63	0.62	0.41	0.41	0.00	0.62	0.62
H1	2.69	1.55	1.76	3.52	2.28	0.20	1.03	3.00	1.24	1.03	0.20	0.62	0.00	0.00
H2	2.69	1.55	1.76	3.52	2.28	0.20	1.03	3.00	1.24	1.03	0.20	0.62	0.00	0.00

PETROLEUM REFINING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.19	0.38	0.52	1.86	0.09	3.91	0.90	4.43	4.86	3.15	4.34	1.76	2.53
HD2	0.19	0.00	0.19	0.33	1.67	0.09	4.10	0.71	4.63	5.06	3.34	4.53	1.95	2.72
HD3	0.38	0.19	0.00	0.14	1.47	0.28	4.29	0.52	4.82	5.25	3.53	4.72	2.14	2.91
HD4	0.52	0.33	0.14	0.00	1.33	0.42	4.43	0.38	4.96	5.39	3.67	4.86	2.29	3.05
HE1	1.86	1.67	1.47	1.33	0.00	1.76	5.77	0.95	6.30	6.73	5.01	6.20	3.62	4.39
HE2	0.09	0.09	0.28	0.42	1.76	0.00	4.01	0.81	4.53	4.96	3.24	4.43	1.86	2.62
HE3	3.91	4.10	4.29	4.43	5.77	4.01	0.00	4.82	0.52	0.95	0.76	0.42	2.14	1.38
HE4	0.90	0.71	0.52	0.38	0.95	0.81	4.82	0.00	5.34	5.77	4.05	5.25	2.67	3.43
HB1	4.43	4.63	4.82	4.96	6.30	4.53	0.52	5.34	0.00	0.42	1.28	0.09	2.67	1.90
HB2	4.86	5.06	5.25	5.39	6.73	4.96	0.95	5.77	0.42	0.00	1.71	0.52	3.10	2.33
HB3	3.15	3.34	3.53	3.67	5.01	3.24	0.76	4.05	1.28	1.71	0.00	1.19	1.38	0.62
HB4	4.34	4.53	4.72	4.86	6.20	4.43	0.42	5.25	0.09	0.52	1.19	0.00	2.57	1.81
H1	1.76	1.95	2.14	2.29	3.62	1.86	2.14	2.67	2.67	3.10	1.38	2.57	0.00	0.76
H2	2.53	2.72	2.91	3.05	4.39	2.62	1.38	3.43	1.90	2.33	0.62	1.81	0.76	0.00

PUBLISHING AND PRINTING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.04	0.53	1.21	1.12	0.31	0.40	2.38	4.31	4.89	3.36	3.05	5.12	4.67
HD2	0.04	0.00	0.49	1.25	1.16	0.26	0.35	2.42	4.26	4.85	3.32	3.01	5.07	4.62
HD3	0.53	0.49	0.00	1.75	1.66	0.22	0.13	2.92	3.77	4.35	2.83	2.51	4.58	4.13
HD4	1.21	1.25	1.75	0.00	0.08	1.52	1.61	1.16	5.52	6.11	4.58	4.26	6.33	5.88
HE1	1.12	1.16	1.66	0.08	0.00	1.43	1.52	1.25	5.43	6.02	4.49	4.17	6.24	5.79
HE2	0.31	0.26	0.22	1.52	1.43	0.00	0.08	2.69	3.99	4.58	3.05	2.74	4.80	4.35
HE3	0.40	0.35	0.13	1.61	1.52	0.08	0.00	2.78	3.90	4.49	2.96	2.65	4.71	4.26
HE4	2.38	2.42	2.92	1.16	1.25	2.69	2.78	0.00	6.69	7.27	5.75	5.43	7.50	7.05
HB1	4.31	4.26	3.77	5.52	5.43	3.99	3.90	6.69	0.00	0.58	0.94	1.25	0.80	0.35
HB2	4.89	4.85	4.35	6.11	6.02	4.58	4.49	7.27	0.58	0.00	1.52	1.84	0.22	0.22
HB3	3.36	3.32	2.83	4.58	4.49	3.05	2.96	5.75	0.94	1.52	0.00	0.31	1.75	1.30
HB4	3.05	3.01	2.51	4.26	4.17	2.74	2.65	5.43	1.25	1.84	0.31	0.00	2.06	1.61
H1	5.12	5.07	4.58	6.33	6.24	4.80	4.71	7.50	0.80	0.22	1.75	2.06	0.00	0.44
H2	4.67	4.62	4.13	5.88	5.79	4.35	4.26	7.05	0.35	0.22	1.30	1.61	0.44	0.00

REAL ESTATE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	1.84	0.67	0.25	0.75	1.51	0.42	1.00	2.10	1.76	2.60	1.76	0.75	0.50
HD2	1.84	0.00	1.17	2.10	1.09	0.33	1.42	0.84	3.95	3.61	4.45	3.61	2.60	2.35
HD3	0.67	1.17	0.00	0.92	0.08	0.84	0.25	0.33	2.77	2.43	3.27	2.43	1.42	1.17
HD4	0.25	2.10	0.92	0.00	1.00	1.76	0.67	1.26	1.84	1.51	2.35	1.51	0.50	0.25
HE1	0.75	1.09	0.08	1.00	0.00	0.75	0.33	0.25	2.85	2.52	3.36	2.52	1.51	1.26
HE2	1.51	0.33	0.84	1.76	0.75	0.00	1.09	0.50	3.61	3.27	4.11	3.27	2.26	2.01
HE3	0.42	1.42	0.25	0.67	0.33	1.09	0.00	0.58	2.52	2.18	3.02	2.18	1.17	0.92
HE4	1.00	0.84	0.33	1.26	0.25	0.50	0.58	0.00	3.11	2.77	3.61	2.77	1.76	1.51
HB1	2.10	3.95	2.77	1.84	2.85	3.61	2.52	3.11	0.00	0.33	0.50	0.33	1.34	1.59
HB2	1.76	3.61	2.43	1.51	2.52	3.27	2.18	2.77	0.33	0.00	0.84	0.00	1.00	1.26
HB3	2.60	4.45	3.27	2.35	3.36	4.11	3.02	3.61	0.50	0.84	0.00	0.84	1.84	2.10
HB4	1.76	3.61	2.43	1.51	2.52	3.27	2.18	2.77	0.33	0.00	0.84	0.00	1.00	1.26
H1	0.75	2.60	1.42	0.50	1.51	2.26	1.17	1.76	1.34	1.00	1.84	1.00	0.00	0.25
H2	0.50	2.35	1.17	0.25	1.26	2.01	0.92	1.51	1.59	1.26	2.10	1.26	0.25	0.00

RESTAURANTS AND SPECIALTY TRADE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	1.00	1.78	0.93	0.21	0.07	1.50	0.57	2.86	2.14	1.71	2.64	4.15	4.07
HD2	1.00	0.00	0.78	1.93	0.78	1.07	2.50	1.57	1.86	1.14	0.71	1.64	3.14	3.07
HD3	1.78	0.78	0.00	2.71	1.57	1.86	3.29	2.36	1.07	0.35	0.07	0.85	2.36	2.29
HD4	0.93	1.93	2.71	0.00	1.14	0.85	0.57	0.35	3.79	3.07	2.64	3.57	5.08	5.00
HE1	0.21	0.78	1.57	1.14	0.00	0.28	1.71	0.78	2.64	1.93	1.50	2.43	3.93	3.86
HE2	0.07	1.07	1.86	0.85	0.28	0.00	1.43	0.50	2.93	2.21	1.78	2.71	4.22	4.15
HE3	1.50	2.50	3.29	0.57	1.71	1.43	0.00	0.93	4.36	3.65	3.22	4.15	5.65	5.58
HE4	0.57	1.57	2.36	0.35	0.78	0.50	0.93	0.00	3.43	2.71	2.29	3.22	4.72	4.65
HB1	2.86	1.86	1.07	3.79	2.64	2.93	4.36	3.43	0.00	0.71	1.14	0.21	1.28	1.21
HB2	2.14	1.14	0.35	3.07	1.93	2.21	3.65	2.71	0.71	0.00	0.42	0.50	2.00	1.93
HB3	1.71	0.71	0.07	2.64	1.50	1.78	3.22	2.29	1.14	0.42	0.00	0.93	2.43	2.36
HB4	2.64	1.64	0.85	3.57	2.43	2.71	4.15	3.22	0.21	0.50	0.93	0.00	1.50	1.43
H1	4.15	3.14	2.36	5.08	3.93	4.22	5.65	4.72	1.28	2.00	2.43	1.50	0.00	0.07
H2	4.07	3.07	2.29	5.00	3.86	4.15	5.58	4.65	1.21	1.93	2.36	1.43	0.07	0.00

RETAIL TRADE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.66	2.11	2.07	0.74	4.60	2.89	1.37	5.26	6.15	3.71	4.37	4.78	5.52
HD2	0.66	0.00	1.44	2.74	0.07	3.93	2.22	2.04	4.60	5.49	3.04	3.71	4.11	4.86
HD3	2.11	1.44	0.00	4.19	1.37	2.48	0.77	3.48	3.15	4.04	1.59	2.26	2.67	3.41
HD4	2.07	2.74	4.19	0.00	2.82	6.67	4.97	0.70	7.34	8.23	5.78	6.45	6.86	7.60
HE1	0.74	0.07	1.37	2.82	0.00	3.85	2.15	2.11	4.52	5.41	2.96	3.63	4.04	4.78
HE2	4.60	3.93	2.48	6.67	3.85	0.00	1.70	5.97	0.66	1.55	0.89	0.22	0.18	0.92
HE3	2.89	2.22	0.77	4.97	2.15	1.70	0.00	4.26	2.37	3.26	0.81	1.48	1.89	2.63
HE4	1.37	2.04	3.48	0.70	2.11	5.97	4.26	0.00	6.64	7.53	5.08	5.75	6.15	6.90
HB1	5.26	4.60	3.15	7.34	4.52	0.66	2.37	6.64	0.00	0.89	1.55	0.89	0.48	0.25
HB2	6.15	5.49	4.04	8.23	5.41	1.55	3.26	7.53	0.89	0.00	2.44	1.78	1.37	0.63
HB3	3.71	3.04	1.59	5.78	2.96	0.89	0.81	5.08	1.55	2.44	0.00	0.66	1.07	1.81
HB4	4.37	3.71	2.26	6.45	3.63	0.22	1.48	5.75	0.89	1.78	0.66	0.00	0.40	1.15
H1	4.78	4.11	2.67	6.86	4.04	0.18	1.89	6.15	0.48	1.37	1.07	0.40	0.00	0.74
H2	5.52	4.86	3.41	7.60	4.78	0.92	2.63	6.90	0.25	0.63	1.81	1.15	0.74	0.00

RUBBER, PLASTIC, AND LEATHER PRODUCTS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.75	0.00	1.51	0.30	0.05	2.06	1.15	0.45	1.51	0.95	0.40	0.30	0.10
HD2	0.75	0.00	0.75	0.75	0.45	0.80	1.31	0.40	1.20	2.26	1.71	0.35	1.05	0.85
HD3	0.00	0.75	0.00	1.51	0.30	0.05	2.06	1.15	0.45	1.51	0.95	0.40	0.30	0.10
HD4	1.51	0.75	1.51	0.00	1.20	1.56	0.55	0.35	1.96	3.02	2.46	1.10	1.81	1.61
HE1	0.30	0.45	0.30	1.20	0.00	0.35	1.76	0.85	0.75	1.81	1.25	0.10	0.60	0.40
HE2	0.05	0.80	0.05	1.56	0.35	0.00	2.11	1.20	0.40	1.46	0.90	0.45	0.25	0.05
HE3	2.06	1.31	2.06	0.55	1.76	2.11	0.00	0.90	2.51	3.57	3.02	1.66	2.36	2.16
HE4	1.15	0.40	1.15	0.35	0.85	1.20	0.90	0.00	1.61	2.67	2.11	0.75	1.46	1.25
HB1	0.45	1.20	0.45	1.96	0.75	0.40	2.51	1.61	0.00	1.05	0.50	0.85	0.15	0.35
HB2	1.51	2.26	1.51	3.02	1.81	1.46	3.57	2.67	1.05	0.00	0.55	1.91	1.20	1.41
HB3	0.95	1.71	0.95	2.46	1.25	0.90	3.02	2.11	0.50	0.55	0.00	1.36	0.65	0.85
HB4	0.40	0.35	0.40	1.10	0.10	0.45	1.66	0.75	0.85	1.91	1.36	0.00	0.70	0.50
H1	0.30	1.05	0.30	1.81	0.60	0.25	2.36	1.46	0.15	1.20	0.65	0.70	0.00	0.20
H2	0.10	0.85	0.10	1.61	0.40	0.05	2.16	1.25	0.35	1.41	0.85	0.50	0.20	0.00

SERVICE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.76	2.20	1.52	1.60	3.08	2.79	0.21	4.48	4.52	3.38	3.68	4.31	4.52
HD2	0.76	0.00	1.43	2.28	0.84	2.32	2.03	0.55	3.72	3.76	2.62	2.91	3.55	3.76
HD3	2.20	1.43	0.00	3.72	0.59	0.88	0.59	1.98	2.28	2.32	1.18	1.48	2.11	2.32
HD4	1.52	2.28	3.72	0.00	3.13	4.61	4.31	1.73	6.00	6.04	4.90	5.20	5.83	6.04
HE1	1.60	0.84	0.59	3.13	0.00	1.48	1.18	1.39	2.87	2.91	1.77	2.07	2.70	2.91
HE2	3.08	2.32	0.88	4.61	1.48	0.00	0.29	2.87	1.39	1.43	0.29	0.59	1.22	1.43
HE3	2.79	2.03	0.59	4.31	1.18	0.29	0.00	2.58	1.69	1.73	0.59	0.88	1.52	1.73
HE4	0.21	0.55	1.98	1.73	1.39	2.87	2.58	0.00	4.27	4.31	3.17	3.46	4.10	4.31
HB1	4.48	3.72	2.28	6.00	2.87	1.39	1.69	4.27	0.00	0.04	1.10	0.80	0.16	0.04
HB2	4.52	3.76	2.32	6.04	2.91	1.43	1.73	4.31	0.04	0.00	1.14	0.84	0.21	0.00
HB3	3.38	2.62	1.18	4.90	1.77	0.29	0.59	3.17	1.10	1.14	0.00	0.29	0.93	1.14
HB4	3.68	2.91	1.48	5.20	2.07	0.59	0.88	3.46	0.80	0.84	0.29	0.00	0.63	0.84
H1	4.31	3.55	2.11	5.83	2.70	1.22	1.52	4.10	0.16	0.21	0.93	0.63	0.00	0.21
H2	4.52	3.76	2.32	6.04	2.91	1.43	1.73	4.31	0.04	0.00	1.14	0.84	0.21	0.00

SOCIAL SERVICES

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.27	0.54	0.81	2.44	3.25	2.84	2.57	5.83	6.51	6.64	5.56	3.93	3.12
HD2	0.27	0.00	0.27	1.08	2.17	2.98	2.57	2.30	5.56	6.24	6.37	5.29	3.66	2.84
HD3	0.54	0.27	0.00	1.35	1.89	2.71	2.30	2.03	5.29	5.97	6.10	5.02	3.39	2.57
HD4	0.81	1.08	1.35	0.00	3.25	4.07	3.66	3.39	6.64	7.32	7.46	6.37	4.74	3.93
HE1	2.44	2.17	1.89	3.25	0.00	0.81	0.40	0.13	3.39	4.07	4.20	3.12	1.49	0.67
HE2	3.25	2.98	2.71	4.07	0.81	0.00	0.40	0.67	2.57	3.25	3.39	2.30	0.67	0.13
HE3	2.84	2.57	2.30	3.66	0.40	0.40	0.00	0.27	2.98	3.66	3.79	2.71	1.08	0.27
HE4	2.57	2.30	2.03	3.39	0.13	0.67	0.27	0.00	3.25	3.93	4.07	2.98	1.35	0.54
HB1	5.83	5.56	5.29	6.64	3.39	2.57	2.98	3.25	0.00	0.67	0.81	0.27	1.89	2.71
HB2	6.51	6.24	5.97	7.32	4.07	3.25	3.66	3.93	0.67	0.00	0.13	0.94	2.57	3.39
HB3	6.64	6.37	6.10	7.46	4.20	3.39	3.79	4.07	0.81	0.13	0.00	1.08	2.71	3.52
HB4	5.56	5.29	5.02	6.37	3.12	2.30	2.71	2.98	0.27	0.94	1.08	0.00	1.62	2.44
H1	3.93	3.66	3.39	4.74	1.49	0.67	1.08	1.35	1.89	2.57	2.71	1.62	0.00	0.81
H2	3.12	2.84	2.57	3.93	0.67	0.13	0.27	0.54	2.71	3.39	3.52	2.44	0.81	0.00

STONE,CLAY,GLASS, AND CONCRETE PRODUCTS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	1.29	0.41	1.11	0.17	1.47	4.18	2.35	2.76	2.00	2.00	2.29	1.06	2.41
HD2	1.29	0.00	1.70	0.17	1.47	2.76	5.48	1.06	4.06	3.30	3.30	3.59	2.35	3.71
HD3	0.41	1.70	0.00	1.53	0.23	1.06	3.77	2.76	2.35	1.59	1.59	1.88	0.64	2.00
HD4	1.11	0.17	1.53	0.00	1.29	2.59	5.30	1.23	3.88	3.12	3.12	3.41	2.18	3.53
HE1	0.17	1.47	0.23	1.29	0.00	1.29	4.00	2.53	2.59	1.82	1.82	2.12	0.88	2.23
HE2	1.47	2.76	1.06	2.59	1.29	0.00	2.71	3.83	1.29	0.53	0.53	0.82	0.41	0.94
HE3	4.18	5.48	3.77	5.30	4.00	2.71	0.00	6.54	1.41	2.18	2.18	1.88	3.12	1.76
HE4	2.35	1.06	2.76	1.23	2.53	3.83	6.54	0.00	5.12	4.36	4.36	4.65	3.41	4.77
HB1	2.76	4.06	2.35	3.88	2.59	1.29	1.41	5.12	0.00	0.76	0.76	0.47	1.70	0.35
HB2	2.00	3.30	1.59	3.12	1.82	0.53	2.18	4.36	0.76	0.00	0.00	0.29	0.94	0.41
HB3	2.00	3.30	1.59	3.12	1.82	0.53	2.18	4.36	0.76	0.00	0.00	0.29	0.94	0.41
HB4	2.29	3.59	1.88	3.41	2.12	0.82	1.88	4.65	0.47	0.29	0.29	0.00	1.23	0.11
H1	1.06	2.35	0.64	2.18	0.88	0.41	3.12	3.41	1.70	0.94	0.94	1.23	0.00	1.35
H2	2.41	3.71	2.00	3.53	2.23	0.94	1.76	4.77	0.35	0.41	0.41	0.11	1.35	0.00

TEXTILES

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.48	1.74	0.38	0.82	0.14	1.25	0.67	0.91	0.96	0.29	0.33	1.64	1.01
HD2	0.48	0.00	2.22	0.87	1.30	0.33	1.74	1.16	0.43	0.48	0.77	0.14	1.16	0.53
HD3	1.74	2.22	0.00	1.35	0.91	1.88	0.48	1.06	2.65	2.70	1.45	2.07	3.38	2.75
HD4	0.38	0.87	1.35	0.00	0.43	0.53	0.87	0.29	1.30	1.35	0.09	0.72	2.03	1.40
HE1	0.82	1.30	0.91	0.43	0.00	0.96	0.43	0.14	1.74	1.78	0.53	1.16	2.46	1.83
HE2	0.14	0.33	1.88	0.53	0.96	0.00	1.40	0.82	0.77	0.82	0.43	0.19	1.49	0.87
HE3	1.25	1.74	0.48	0.87	0.43	1.40	0.00	0.58	2.17	2.22	0.96	1.59	2.90	2.27
HE4	0.67	1.16	1.06	0.29	0.14	0.82	0.58	0.00	1.59	1.64	0.38	1.01	2.32	1.69
HB1	0.91	0.43	2.65	1.30	1.74	0.77	2.17	1.59	0.00	0.04	1.20	0.58	0.72	0.09
HB2	0.96	0.48	2.70	1.35	1.78	0.82	2.22	1.64	0.04	0.00	1.25	0.62	0.67	0.04
HB3	0.29	0.77	1.45	0.09	0.53	0.43	0.96	0.38	1.20	1.25	0.00	0.62	1.93	1.30
HB4	0.33	0.14	2.07	0.72	1.16	0.19	1.59	1.01	0.58	0.62	0.62	0.00	1.30	0.67
H1	1.64	1.16	3.38	2.03	2.46	1.49	2.90	2.32	0.72	0.67	1.93	1.30	0.00	0.62
H2	1.01	0.53	2.75	1.40	1.83	0.87	2.27	1.69	0.09	0.04	1.30	0.67	0.62	0.00

TRANSPORTATION

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.10	0.25	0.55	0.10	0.10	2.26	0.65	2.62	3.52	0.75	2.77	1.51	1.81
HD2	0.10	0.00	0.15	0.45	0.00	0.00	2.36	0.55	2.72	3.63	0.65	2.87	1.61	1.91
HD3	0.25	0.15	0.00	0.30	0.15	0.15	2.52	0.40	2.87	3.78	0.50	3.02	1.76	2.06
HD4	0.55	0.45	0.30	0.00	0.45	0.45	2.82	0.10	3.17	4.08	0.20	3.32	2.06	2.36
HE1	0.10	0.00	0.15	0.45	0.00	0.00	2.36	0.55	2.72	3.63	0.65	2.87	1.61	1.91
HE2	0.10	0.00	0.15	0.45	0.00	0.00	2.36	0.55	2.72	3.63	0.65	2.87	1.61	1.91
HE3	2.26	2.36	2.52	2.82	2.36	2.36	0.00	2.92	0.35	1.26	3.02	0.50	0.75	0.45
HE4	0.65	0.55	0.40	0.10	0.55	0.55	2.92	0.00	3.27	4.18	0.10	3.42	2.16	2.47
HB1	2.62	2.72	2.87	3.17	2.72	2.72	0.35	3.27	0.00	0.90	3.37	0.15	1.10	0.80
HB2	3.52	3.63	3.78	4.08	3.63	3.63	1.26	4.18	0.90	0.00	4.28	0.75	2.01	1.71
HB3	0.75	0.65	0.50	0.20	0.65	0.65	3.02	0.10	3.37	4.28	0.00	3.52	2.26	2.57
HB4	2.77	2.87	3.02	3.32	2.87	2.87	0.50	3.42	0.15	0.75	3.52	0.00	1.26	0.95
H1	1.51	1.61	1.76	2.06	1.61	1.61	0.75	2.16	1.10	2.01	2.26	1.26	0.00	0.30
H2	1.81	1.91	2.06	2.36	1.91	1.91	0.45	2.47	0.80	1.71	2.57	0.95	0.30	0.00

TRANSPORTATION EQUIP

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.49	2.87	1.25	0.90	2.73	3.91	0.97	5.29	5.01	3.87	5.05	3.68	4.29
HD2	0.49	0.00	2.37	1.75	0.40	2.23	3.42	1.47	4.79	4.51	3.37	4.56	3.18	3.80
HD3	2.87	2.37	0.00	4.13	1.97	0.14	1.04	3.84	2.42	2.13	0.99	2.18	0.80	1.42
HD4	1.25	1.75	4.13	0.00	2.16	3.99	5.17	0.28	6.55	6.27	5.13	6.31	4.94	5.55
HE1	0.90	0.40	1.97	2.16	0.00	1.82	3.01	1.87	4.39	4.10	2.96	4.15	2.77	3.39
HE2	2.73	2.23	0.14	3.99	1.82	0.00	1.18	3.70	2.56	2.28	1.14	2.32	0.95	1.56
HE3	3.91	3.42	1.04	5.17	3.01	1.18	0.00	4.89	1.37	1.09	0.04	1.14	0.23	0.38
HE4	0.97	1.47	3.84	0.28	1.87	3.70	4.89	0.00	6.27	5.98	4.84	6.03	4.65	5.27
HB1	5.29	4.79	2.42	6.55	4.39	2.56	1.37	6.27	0.00	0.28	1.42	0.23	1.61	0.99
HB2	5.01	4.51	2.13	6.27	4.10	2.28	1.09	5.98	0.28	0.00	1.14	0.04	1.33	0.71
HB3	3.87	3.37	0.99	5.13	2.96	1.14	0.04	4.84	1.42	1.14	0.00	1.18	0.19	0.42
HB4	5.05	4.56	2.18	6.31	4.15	2.32	1.14	6.03	0.23	0.04	1.18	0.00	1.37	0.76
H1	3.68	3.18	0.80	4.94	2.77	0.95	0.23	4.65	1.61	1.33	0.19	1.37	0.00	0.61
H2	4.29	3.80	1.42	5.55	3.39	1.56	0.38	5.27	0.99	0.71	0.42	0.76	0.61	0.00

UTILITIES

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	2.13	5.50	2.83	1.80	0.48	3.12	0.87	9.00	10.9	7.29	6.99	3.33	2.17
HD2	2.13	0.00	3.37	0.70	3.93	1.65	0.99	1.25	11.1	13.0	9.42	9.12	5.46	4.30
HD3	5.50	3.37	0.00	2.66	7.30	5.02	2.38	4.62	14.5	16.4	12.7	12.4	8.83	7.67
HD4	2.83	0.70	2.66	0.00	4.63	2.35	0.28	1.96	11.8	13.7	10.1	9.82	6.17	5.01
HE1	1.80	3.93	7.30	4.63	0.00	2.28	4.92	2.67	7.20	9.13	5.49	5.19	1.53	0.37
HE2	0.48	1.65	5.02	2.35	2.28	0.00	2.64	0.39	9.48	11.4	7.77	7.47	3.81	2.65
HE3	3.12	0.99	2.38	0.28	4.92	2.64	0.00	2.24	12.1	14.0	10.4	10.1	6.45	5.29
HE4	0.87	1.25	4.62	1.96	2.67	0.39	2.24	0.00	9.88	11.8	8.16	7.86	4.20	3.05
HB1	9.00	11.1	14.5	11.8	7.20	9.48	12.1	9.88	0.00	1.92	1.71	2.01	5.67	6.83
HB2	10.9	13.0	16.4	13.7	9.13	11.4	14.0	11.8	1.92	0.00	3.63	3.94	7.59	8.75
HB3	7.29	9.42	12.7	10.1	5.49	7.77	10.4	8.16	1.71	3.63	0.00	0.30	3.96	5.11
HB4	6.99	9.12	12.4	9.82	5.19	7.47	10.1	7.86	2.01	3.94	0.30	0.00	3.65	4.81
H1	3.33	5.46	8.83	6.17	1.53	3.81	6.45	4.20	5.67	7.59	3.96	3.65	0.00	1.15
H2	2.17	4.30	7.67	5.01	0.37	2.65	5.29	3.05	6.83	8.75	5.11	4.81	1.15	0.00

WHOLESALE TRADE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
HD1	0.00	0.04	0.17	1.58	0.90	2.35	1.67	1.37	2.83	3.55	3.30	1.88	3.04	3.00
HD2	0.04	0.00	0.12	1.62	0.94	2.31	1.62	1.41	2.78	3.51	3.25	1.84	3.00	2.95
HD3	0.17	0.12	0.00	1.75	1.07	2.18	1.50	1.54	2.65	3.38	3.13	1.71	2.87	2.83
HD4	1.58	1.62	1.75	0.00	0.68	3.94	3.25	0.21	4.41	5.14	4.88	3.47	4.63	4.58
HE1	0.90	0.94	1.07	0.68	0.00	3.25	2.57	0.47	3.73	4.46	4.20	2.78	3.94	3.90
HE2	2.35	2.31	2.18	3.94	3.25	0.00	0.68	3.73	0.47	1.20	0.94	0.47	0.68	0.64
HE3	1.67	1.62	1.50	3.25	2.57	0.68	0.00	3.04	1.15	1.88	1.62	0.21	1.37	1.32
HE4	1.37	1.41	1.54	0.21	0.47	3.73	3.04	0.00	4.20	4.93	4.67	3.25	4.41	4.37
HB1	2.83	2.78	2.65	4.41	3.73	0.47	1.15	4.20	0.00	0.72	0.47	0.94	0.21	0.17
HB2	3.55	3.51	3.38	5.14	4.46	1.20	1.88	4.93	0.72	0.00	0.25	1.67	0.51	0.55
HB3	3.30	3.25	3.13	4.88	4.20	0.94	1.62	4.67	0.47	0.25	0.00	1.41	0.25	0.30
HB4	1.88	1.84	1.71	3.47	2.78	0.47	0.21	3.25	0.94	1.67	1.41	0.00	1.15	1.11
H1	3.04	3.00	2.87	4.63	3.94	0.68	1.37	4.41	0.21	0.51	0.25	1.15	0.00	0.04
H2	3.00	2.95	2.83	4.58	3.90	0.64	1.32	4.37	0.17	0.55	0.30	1.11	0.04	0.00

APPENDIX 5

FORECASTS BY HISTORICAL METHODS AND IBES FORECASTS: PAIRWISE COMPARISON OF FORECAST AGREEMENT

AGRICULTURE AND MINING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	2.11	0.87	2.16	2.84	3.27	1.00	0.62	2.67	1.99	2.50	0.62	1.81	0.02	0.10
HIIBES	1.71	2.95	1.66	0.98	0.55	2.82	4.45	1.15	5.82	6.33	4.45	5.64	3.85	3.93
MNIBES	0.19	1.43	0.14	0.53	0.96	1.30	2.93	0.36	4.30	4.81	2.93	4.12	2.33	2.41
MDIBES	0.25	1.49	0.21	0.47	0.89	1.36	2.99	0.29	4.36	4.87	2.99	4.19	2.39	2.48

BANKING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	5.70	1.81	0.50	4.61	1.57	0.48	2.35	1.52	8.27	6.97	3.73	7.09	6.65	6.53
HIIBES	12.21	8.33	6.00	11.1	8.08	6.02	8.86	4.98	14.7	13.4	10.2	13.6	13.1	13.0
MNIBES	9.81	5.93	3.60	8.72	5.68	3.62	6.46	2.58	12.3	11.0	7.8	11.2	10.7	10.6
MDIBES	9.28	5.39	3.07	8.19	5.15	3.09	5.93	2.05	11.8	10.5	7.3	10.6	10.2	10.1

CHEMICALS AND DRUGS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.58	1.18	0.91	1.25	0.47	2.50	4.10	0.97	6.77	6.68	5.11	5.43	4.78	4.95
HIIBES	7.60	8.20	7.94	5.76	7.49	9.53	11.1	6.0	13.8	13.7	12.1	12.4	11.8	11.9
MNIBES	5.06	5.66	5.40	3.22	4.95	6.99	8.59	3.51	11.2	11.1	9.5	9.9	9.2	9.4
MDIBES	5.13	5.73	5.47	3.29	5.02	7.05	8.65	3.57	11.3	11.2	9.66	9.99	9.33	9.51

COMMUNICATIONS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.28	0.46	1.78	1.21	0.18	1.50	0.75	0.46	0.09	1.12	0.56	0.09	0.56	0.75
HIIBES	2.06	1.87	4.12	1.12	2.53	3.84	3.09	1.87	2.43	3.47	2.90	2.25	2.90	3.09
MNIBES	1.40	1.21	3.47	0.46	1.87	3.18	2.43	1.21	1.78	2.81	2.25	1.59	2.25	2.43
MDIBES	1.31	1.12	3.37	0.37	1.78	3.09	2.34	1.12	1.68	2.72	2.15	1.50	2.15	2.34

CONSTRUCTION

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.09	0.74	0.65	0.37	0.74	1.48	0.65	0.55	0.27	0.74	1.58	0.65	0.09	0.74
HIIBES	1.20	1.85	0.46	0.74	0.37	0.37	0.46	0.55	1.39	1.85	0.46	1.76	1.02	0.37
MNIBES	0.60	1.25	0.13	0.13	0.23	0.97	0.13	0.04	0.79	1.25	1.06	1.16	0.41	0.23
MDIBES	0.79	1.44	0.04	0.32	0.04	0.79	0.04	0.13	0.97	1.44	0.88	1.34	0.60	0.04

CONSUMER GOODS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.98	1.24	0.01	2.30	0.43	1.32	0.61	1.59	4.23	4.63	2.58	3.96	3.88	3.80
HIIBES	3.84	3.58	4.84	2.52	5.26	6.14	5.43	3.23	9.06	9.45	7.40	8.78	8.70	8.63
MNIBES	2.02	1.77	3.03	0.70	3.44	4.33	3.62	1.41	7.25	7.64	5.59	6.97	6.89	6.81
MDIBES	1.65	1.39	2.66	0.33	3.07	3.96	3.25	1.04	6.87	7.27	5.22	6.60	6.52	6.44

ELECTRONICS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.91	1.48	3.68	1.34	0.24	2.74	2.12	1.75	7.33	6.97	4.80	6.45	5.09	4.59
HIIBES	6.71	7.28	9.48	4.45	6.04	8.54	7.92	4.03	13.1	12.7	10.6	12.2	10.8	10.3
MNIBES	4.36	4.93	7.14	2.11	3.70	6.20	5.57	1.69	10.7	10.4	8.2	9.9	8.5	8.0
MDIBES	4.06	4.63	6.84	1.81	3.40	5.90	5.27	1.39	10.4	10.1	7.96	9.60	8.24	7.75

FOOD AND BEVERAGE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.96	0.11	2.56	1.54	2.38	0.14	2.18	4.42	6.40	5.65	2.12	5.59	5.73	4.71
HIIBES	6.85	6.01	3.33	4.35	3.50	5.75	3.71	1.47	12.3	11.5	8.02	11.4	11.6	10.6
MNIBES	4.01	3.17	0.49	1.51	0.66	2.91	0.87	1.36	9.46	8.70	5.18	8.65	8.79	7.77
MDIBES	4.03	3.18	0.50	1.52	0.68	2.92	0.88	1.35	9.48	8.72	5.19	8.66	8.81	7.79

FOREST PRODUCTS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	2.24	0.95	0.98	2.89	2.28	0.44	1.74	2.17	2.17	2.39	2.10	1.88	1.63	2.71
HIIBES	3.16	4.45	6.40	2.51	3.12	5.86	7.15	3.23	7.58	7.80	7.51	7.30	7.04	8.12
MNIBES	1.22	2.51	4.45	0.57	1.18	3.92	5.21	1.29	5.64	5.86	5.57	5.35	5.10	6.18
MDIBES	0.88	2.17	4.11	0.23	0.84	3.57	4.87	0.95	5.30	5.52	5.23	5.01	4.76	5.84

MACHINERY

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.52	0.63	2.21	1.22	0.34	2.55	3.58	2.18	6.03	4.79	5.04	5.72	2.34	3.11
HIIBES	5.95	6.06	7.64	4.20	5.08	7.98	9.01	3.24	11.4	10.2	10.4	11.1	7.7	8.5
MNIBES	4.00	4.11	5.69	2.24	3.13	6.03	7.05	1.28	9.50	8.26	8.51	9.19	5.81	6.59
MDIBES	3.78	3.89	5.47	2.03	2.91	5.81	6.84	1.07	9.29	8.05	8.29	8.98	5.60	6.37

METALS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	1.58	0.57	0.54	2.44	2.00	0.16	1.05	2.09	4.25	5.56	2.62	4.34	2.12	2.35
HIIBES	2.86	3.87	5.00	2.00	2.44	4.61	5.50	2.35	8.71	10.0	7.0	8.8	6.5	6.8
MNIBES	1.11	2.12	3.25	0.25	0.69	2.86	3.75	0.60	6.96	8.26	5.32	7.04	4.82	5.06
MDIBES	1.05	2.06	3.19	0.19	0.63	2.80	3.69	0.54	6.90	8.20	5.26	6.99	4.76	5.00

NON-BANK FINANCE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	4.11	4.83	1.87	7.19	0.97	2.48	2.41	5.59	3.89	2.20	2.44	1.58	2.69	3.71
HIIBES	2.58	1.86	4.82	0.49	5.73	9.18	9.11	1.10	10.5	8.90	9.15	8.28	9.39	10.4
MNIBES	0.10	0.83	2.12	3.18	3.03	6.48	6.42	1.58	7.90	6.20	6.45	5.59	6.70	7.71
MDIBES	0.06	0.66	2.29	3.01	3.20	6.65	6.59	1.41	8.07	6.37	6.62	5.76	6.87	7.88

OFFICE EQUIPMENT

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	1.45	0.75	0.48	3.04	1.10	1.45	2.16	2.16	2.69	2.42	1.81	2.07	1.54	1.63
HIIBES	0.92	1.63	1.89	0.66	1.28	3.84	4.54	0.22	5.08	4.81	4.19	4.46	3.93	4.01
MNIBES	0.04	0.75	1.01	1.54	0.39	2.95	3.66	0.66	4.19	3.93	3.31	3.57	3.04	3.13
MDIBES	0.13	0.57	0.83	1.72	0.22	2.78	3.48	0.83	4.01	3.75	3.13	3.40	2.87	2.95

PETROLEUM REFINING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	2.88	3.08	3.39	3.23	4.88	3.16	1.35	3.67	1.90	2.13	0.45	1.82	0.84	0.05
HIIBES	3.86	3.67	3.35	3.51	1.86	3.59	8.10	3.08	8.65	8.89	7.20	8.57	5.90	6.69
MNIBES	0.54	0.35	0.03	0.19	1.45	0.27	4.79	0.23	5.33	5.57	3.88	5.26	2.59	3.37
MDIBES	0.47	0.27	0.03	0.11	1.53	0.19	4.71	0.31	5.26	5.49	3.80	5.18	2.51	3.29

PUBLISHING AND PRINTING

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.07	0.61	0.73	1.12	0.69	0.77	0.38	2.12	4.91	5.46	3.87	3.83	5.65	5.26
HIIBES	4.99	5.53	5.65	3.79	4.22	5.69	5.30	2.78	9.83	10.3	8.79	8.75	10.5	10.1
MNIBES	2.84	3.38	3.50	1.64	2.07	3.54	3.15	0.63	7.68	8.22	6.64	6.60	8.42	8.03
MDIBES	2.61	3.15	3.27	1.41	1.83	3.31	2.92	0.40	7.45	7.99	6.40	6.37	8.19	7.80

REAL ESTATE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.43	1.69	0.56	0.63	0.43	1.29	0.09	0.63	2.69	2.16	3.09	2.42	1.36	1.16
HIIBES	1.03	1.09	0.03	1.23	0.16	0.69	0.49	0.03	3.29	2.76	3.69	3.02	1.96	1.76
MNIBES	0.89	1.23	0.09	1.09	0.03	0.83	0.36	0.16	3.16	2.62	3.55	2.89	1.82	1.63
MDIBES	0.83	1.29	0.16	1.03	0.03	0.89	0.29	0.23	3.09	2.56	3.49	2.82	1.76	1.56

RESTAURANTS AND SPECIALTY TRADE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	1.54	0.11	0.59	2.49	1.06	1.30	2.84	2.07	2.07	1.30	0.65	1.78	3.14	3.08
HIIBES	2.01	3.44	4.15	1.06	2.49	2.25	0.71	1.48	5.63	4.86	4.21	5.34	6.70	6.64
MNIBES	0.29	1.72	2.43	0.65	0.77	0.53	1.00	0.23	3.91	3.14	2.49	3.62	4.98	4.92
MDIBES	0.11	1.54	2.25	0.83	0.59	0.35	1.18	0.41	3.73	2.96	2.31	3.44	4.80	4.74

RETAIL TRADE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	1.80	0.99	0.24	4.17	1.09	3.02	0.90	3.36	4.04	4.85	2.24	3.20	3.67	4.32
HIIBES	3.44	4.25	5.49	1.07	4.15	8.27	6.15	1.88	9.29	10.1	7.49	8.45	8.92	9.57
MNIBES	1.13	1.94	3.19	1.23	1.85	5.96	3.84	0.42	6.99	7.80	5.18	6.15	6.61	7.27
MDIBES	1.18	1.99	3.23	1.18	1.90	6.01	3.89	0.37	7.03	7.84	5.23	6.19	6.66	7.32

RUBBER, PLASTIC AND LEATHER PRODUCTS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	2.00	1.25	1.83	0.28	1.56	2.00	0.72	0.72	2.62	3.55	3.06	1.87	2.44	2.44
HIIBES	3.81	3.06	3.63	2.09	3.37	3.81	1.08	2.53	4.43	5.35	4.87	3.68	4.25	4.25
MNIBES	2.99	2.24	2.82	1.27	2.55	2.99	0.26	1.72	3.61	4.54	4.05	2.86	3.44	3.44
MDIBES	3.13	2.38	2.95	1.41	2.69	3.13	0.39	1.85	3.74	4.67	4.19	2.99	3.57	3.57

SERVICE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	2.18	1.11	0.25	3.63	0.29	1.56	0.74	1.67	2.66	2.84	1.77	2.01	2.87	3.01
HIIBES	1.34	2.41	3.78	0.10	3.23	5.09	4.27	1.86	6.20	6.37	5.30	5.54	6.40	6.54
MNIBES	0.37	0.68	2.06	1.82	1.51	3.37	2.54	0.13	4.47	4.65	3.58	3.82	4.68	4.82
MDIBES	0.53	0.53	1.91	1.98	1.36	3.22	2.39	0.01	4.32	4.49	3.42	3.66	4.53	4.66

SOCIAL SERVICES

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	1.88	1.69	1.14	2.48	0.59	1.19	0.59	0.69	3.47	3.97	3.77	3.28	2.08	1.39
HIIBES	1.24	1.44	1.98	0.64	3.72	4.32	3.72	3.82	6.61	7.10	6.90	6.41	5.21	4.52
MNIBES	0.34	0.14	0.39	0.94	2.13	2.73	2.13	2.23	5.02	5.51	5.31	4.82	3.62	2.93
MDIBES	0.74	0.54	0.00	1.34	1.73	2.33	1.73	1.83	4.62	5.12	4.92	4.42	3.23	2.53

STONE,CLAY, GLASS AND CONCRETE PRODUCTS

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.24	1.15	0.45	1.04	0.34	1.42	4.26	2.76	3.08	2.11	2.27	2.54	1.52	2.81
HIIBES	5.25	3.86	5.47	3.96	5.36	6.43	9.28	2.25	8.09	7.13	7.29	7.56	6.54	7.83
MNIBES	3.35	1.95	3.56	2.06	3.45	4.53	7.37	0.34	6.19	5.23	5.39	5.65	4.64	5.92
MDIBES	2.95	1.55	3.16	1.66	3.05	4.13	6.97	0.05	5.79	4.82	4.98	5.25	4.23	5.52

TEXTILES

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.89	1.83	1.19	0.68	0.17	1.06	0.85	0.12	2.39	2.43	0.81	1.79	3.07	2.43
HIIBES	3.84	4.78	1.75	3.63	3.12	4.01	2.09	3.07	5.34	5.38	3.76	4.74	6.02	5.38
MNIBES	2.48	3.42	0.38	2.26	1.75	2.65	0.72	1.71	3.97	4.01	2.39	3.37	4.66	4.01
MDIBES	2.43	3.37	0.34	2.22	1.71	2.60	0.68	1.66	3.93	3.97	2.35	3.33	4.61	3.97

TRANSPORTATION

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.17	0.04	0.53	0.44	0.04	0.04	2.03	0.62	2.97	3.85	0.57	3.05	1.90	2.17
HIIBES	4.16	4.03	3.45	3.54	4.03	4.03	6.02	3.36	6.96	7.84	3.41	7.04	5.89	6.16
MNIBES	2.92	2.79	2.21	2.30	2.79	2.79	4.78	2.12	5.71	6.60	2.17	5.80	4.65	4.92
MDIBES	2.79	2.66	2.08	2.17	2.66	2.66	4.65	1.99	5.58	6.47	2.03	5.67	4.52	4.78

TRANSPORTATION EQUIPMENT

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	1.24	0.66	1.79	2.63	0.40	1.51	2.43	2.31	4.29	4.01	2.92	4.09	2.59	3.32
HIIBES	3.20	3.78	6.24	1.81	4.05	5.96	6.89	2.13	8.74	8.46	7.37	8.54	7.05	7.77
MNIBES	1.53	2.11	4.57	0.14	2.37	4.29	5.21	0.46	7.07	6.79	5.70	6.87	5.38	6.10
MDIBES	1.06	1.65	4.11	0.32	1.91	3.82	4.75	0.00	6.60	6.32	5.23	6.40	4.91	5.64

UTILITIES

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.76	2.86	7.20	3.75	1.29	1.68	5.62	1.69	8.91	10.5	6.63	6.99	3.15	1.69
HIIBES	11.50	9.40	5.05	8.50	13.5	10.5	6.64	10.5	21.1	22.8	18.8	19.2	15.4	13.9
MNIBES	6.50	4.41	0.06	3.51	8.56	5.59	1.65	5.57	16.1	17.8	13.9	14.2	10.4	8.97
MDIBES	6.02	3.93	0.41	3.03	8.08	5.11	1.17	5.09	15.7	17.3	13.4	13.7	9.95	8.49

WHOLESALE TRADE

	HD1	HD2	HD3	HD4	HE1	HE2	HE3	HE4	HB1	HB2	HB3	HB4	H1	H2
LOIBES	0.46	0.49	0.46	1.31	0.64	2.82	1.90	1.05	3.78	4.41	4.00	3.01	3.97	3.67
HIIBES	3.89	3.93	3.89	2.12	2.78	6.26	5.33	2.38	7.22	7.84	7.44	6.44	7.40	7.11
MNIBES	2.21	2.25	2.21	0.44	1.10	4.58	3.65	0.70	5.54	6.16	5.76	4.76	5.72	5.42
MDIBES	2.32	2.36	2.32	0.55	1.21	4.69	3.76	0.81	5.65	6.27	5.87	4.87	5.83	5.54

APPENIDIX 6

DECOMPOSITION OF FORECAST ERROR:
DECOMPOSED BY BIAS, EFFICIENCY, AND RANDOM ERROR.
FORECAST ERRORS ASSESSED AGAINST ACTUAL EARNINGS GROWTH

INDUSTRY	HD1 MSFE	HD1 BIAS (%)	HD1 INEFFI-CIENCY (%)	HD1 RANDOM (%)	HD2 MSFE	HD2 BIAS (%)	HD2 INEFFI-CIENCY (%)	HD2 RANDOM (%)
AGRICULTURE AND MINING	0.09	0.09	61.61	38.29	0.07	6.28	26.43	67.28
BANKING	0.04	28.77	15.43	55.79	0.04	19.81	23.83	56.34
CHEMICALS AND DRUGS	0.05	3.81	25.23	70.94	0.05	3.22	20.40	76.36
COMMUNICATIONS	NMF	0.00	50.00	50.00	NMF	0.00	50.00	50.00
CONSTRUCTION	0.07	40.34	59.65	0.00	0.05	9.92	0.14	89.93
CONSUMER GOODS	0.06	40.00	17.61	42.38	0.06	29.39	0.33	70.27
ELECTRONICS	0.04	37.47	23.34	39.18	0.04	33.84	24.37	41.77
FOOD AND BEVERAGE	0.01	1.33	9.10	89.56	0.01	1.09	16.11	82.79
FOREST PRODUCTS	0.02	37.51	6.89	55.59	0.01	16.69	8.86	74.44
MACHINERY	0.10	39.06	32.21	28.72	0.09	36.08	17.39	46.51
METALS	0.12	2.45	29.56	67.97	0.08	3.60	0.36	96.03
NON-BANK FINANCE	0.02	3.17	47.68	49.14	0.01	8.66	26.76	64.56
OFFICE EQUIPMENT	0.06	52.45	25.19	22.34	0.04	47.94	11.51	40.53
PETROLEUM REFINING	0.08	47.72	9.26	43.01	0.09	47.93	10.99	41.07
PUBLISHING AND PRINT	0.01	2.69	38.62	58.68	0.01	8.72	37.54	53.73
REAL ESTATE	0.06	3.22	75.96	20.81	0.07	33.51	24.02	42.46
RESTAURANTS AND SPEC TRADE	0.03	7.82	52.61	39.56	0.04	27.67	37.06	35.26
RETAIL TRADE	0.03	37.50	12.94	49.54	0.03	28.95	7.41	63.63
RUBBER, PLASTIC, AND LEATHER	0.04	1.92	24.41	73.66	0.04	0.00	38.81	61.18
SERVICE	0.03	22.13	15.70	62.15	0.03	24.82	15.07	60.09
SOCIAL SERVICES	0.02	94.60	0.66	4.73	0.39	0.28	83.24	16.47
STONE,CLAY,GLASS, AND CONCRETE	0.05	12.33	33.26	54.39	0.05	15.49	26.87	57.63
TEXTILES	0.06	9.16	5.39	85.43	0.07	8.54	28.79	62.66
TRANSPORTATION	0.05	7.55	1.82	90.62	0.05	3.18	22.86	73.95
TRANSPORTATION EQUIP	0.06	0.29	24.19	75.51	0.07	0.05	44.77	55.17
UTILITIES	0.02	9.80	14.73	75.45	0.02	7.00	18.45	74.54
WHOLESALE TRADE	0.08	15.01	58.51	26.46	0.03	27.71	1.04	71.24

INDUSTRY	HD3 MSFE	HD3 BIAS (%)	HD3 INEFFI-CIENCY (%)	HD3 RANDOM (%)	HD4 MSFE	HD4 BIAS (%)	HD4 INEFFI-CIENCY (%)	HD4 RANDOM (%)
AGRICULTURE AND MINING	0.06	12.02	18.83	69.13	0.09	26.14	12.72	61.13
BANKING	0.04	12.77	30.38	56.83	0.04	27.59	18.85	53.54
CHEMICALS AND DRUGS	0.05	2.34	19.91	77.74	0.05	6.26	27.86	65.87
COMMUNICATIONS	0.02	33.55	66.44	0.00	NMF	0.00	50.00	50.00
CONSTRUCTION	0.08	0.12	45.16	54.70	0.05	21.55	18.70	59.73
CONSUMER GOODS	0.07	17.54	25.39	57.06	0.08	46.67	22.48	30.84
ELECTRONICS	0.04	22.55	29.74	47.70	0.05	41.30	20.07	38.62
FOOD AND BEVERAGE	0.02	0.49	27.31	72.18	0.01	0.00	12.52	87.46
FOREST PRODUCTS	0.04	7.46	22.09	70.44	0.02	26.15	0.97	72.87
MACHINERY	0.11	23.42	36.26	40.30	0.10	41.56	20.82	37.61
METALS	0.10	1.01	20.28	78.69	0.12	3.39	33.71	62.89
NON-BANK FINANCE	0.02	0.62	60.71	38.65	0.01	16.22	30.97	52.80
OFFICE EQUIPMENT	0.05	44.83	28.01	27.15	0.07	59.62	24.39	15.98
PETROLEUM REFINING	0.12	38.55	39.24	22.20	0.08	51.74	4.51	43.73
PUBLISHING AND PRINT	0.03	15.58	58.28	26.13	0.01	0.85	37.99	61.15
REAL ESTATE	0.06	3.79	48.64	47.55	0.06	2.02	74.15	23.82
RESTAURANTS AND SPEC TRADE	0.03	1.22	41.88	56.89	0.07	31.32	49.00	19.66
RETAIL TRADE	0.02	15.93	13.59	70.47	0.03	41.38	8.57	50.03
RUBBER, PLASTIC, AND LEATHER	0.04	0.46	45.94	53.58	0.04	0.00	27.10	72.88
SERVICE	0.05	5.91	68.50	25.58	0.03	33.82	11.19	54.98
SOCIAL SERVICES	0.32	1.51	59.35	39.13	0.05	66.80	5.75	27.43
STONE,CLAY,GLASS, AND CONCRETE	0.05	9.60	16.32	74.06	0.05	14.93	34.48	50.57
TEXTILES	0.06	5.02	21.19	73.78	0.06	11.83	18.03	70.13
TRANSPORTATION	0.11	4.59	67.19	28.20	0.06	4.60	16.88	78.51
TRANSPORTATION EQUIP	0.06	4.63	44.56	50.80	0.05	1.72	27.16	71.11
UTILITIES	0.02	3.85	17.70	78.43	0.02	7.86	18.05	74.08
WHOLESALE TRADE	0.04	22.25	0.00	77.74	0.09	27.45	43.09	29.45

INDUSTRY	HE1 MSFE	HE1 BIAS (%)	HE1 INEFFI-CIENCY (%)	HE1 RANDOM (%)	HE2 MSFE	HE2 BIAS (%)	HE2 INEFFI-CIENCY (%)	HE2 RANDOM (%)
AGRICULTURE AND MINING	0.10	0.00	61.33	38.66	0.11	0.38	50.96	48.65
BANKING	0.04	19.24	35.24	45.50	0.03	9.40	18.33	72.26
CHEMICALS AND DRUGS	0.06	1.78	58.00	40.21	0.07	0.14	55.46	44.38
COMMUNICATIONS	0.09	48.91	39.57	11.51	0.11	30.08	61.21	8.69
CONSTRUCTION	0.12	0.03	99.44	0.52	0.16	2.51	96.32	1.16
CONSUMER GOODS	0.10	15.21	46.24	38.53	0.08	6.68	40.10	53.20
ELECTRONICS	0.05	43.89	18.00	38.09	0.04	26.72	20.16	53.10
FOOD AND BEVERAGE	0.02	0.28	24.69	75.01	0.02	0.38	33.57	66.03
FOREST PRODUCTS	0.04	6.27	27.67	66.05	0.05	0.00	58.08	41.91
MACHINERY	0.10	27.78	42.63	29.58	0.11	25.98	45.05	28.95
METALS	0.12	0.69	49.13	50.16	0.11	0.43	65.59	33.96
NON-BANK FINANCE	0.01	0.00	17.73	82.26	0.01	0.78	37.35	61.85
OFFICE EQUIPMENT	0.04	53.46	10.80	35.72	0.02	30.77	40.05	29.16
PETROLEUM REFINING	0.10	46.40	31.36	22.22	0.13	37.07	45.29	17.63
PUBLISHING AND PRINT	0.01	5.34	34.21	60.43	0.02	6.31	48.08	45.60
REAL ESTATE	0.06	3.12	33.41	63.45	0.17	16.30	73.52	10.16
RESTAURANTS AND SPEC TRADE	0.04	1.48	53.42	45.08	0.04	0.68	50.87	48.43
RETAIL TRADE	0.02	25.13	5.64	69.21	0.02	9.84	9.82	80.33
RUBBER, PLASTIC, AND LEATHER	0.05	0.06	64.90	35.03	0.07	1.97	73.74	24.27
SERVICE	0.06	5.44	24.44	70.11	0.12	0.03	85.62	14.34
SOCIAL SERVICES	0.03	25.39	2.60	71.99	0.02	26.07	6.72	67.19
STONE,CLAY,GLASS, AND CONCRETE	0.06	9.01	33.21	57.76	0.06	2.78	33.32	63.88
TEXTILES	0.06	14.70	6.03	79.26	0.08	10.37	44.35	45.27
TRANSPORTATION	0.15	1.08	48.16	50.75	0.23	3.19	79.01	17.78
TRANSPORTATION EQUIP	0.08	0.04	72.40	27.54	0.12	4.42	76.92	18.65
UTILITIES	0.03	11.74	32.60	55.65	0.03	9.00	39.90	51.08
WHOLESALE TRADE	0.07	17.27	52.37	30.35	0.07	12.58	38.93	48.47

INDUSTRY	HE3				HE4			
	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)
AGRICULTURE AND MINING	0.09	0.56	49.45	49.98	0.09	36.50	9.64	53.85
BANKING	0.06	21.76	37.33	40.89	0.04	15.63	28.12	56.23
CHEMICALS AND DRUGS	0.05	0.53	58.39	41.06	0.06	3.80	45.40	50.78
COMMUNICATIONS	0.00	82.88	17.11	0.00	0.01	99.90	0.09	0.00
CONSTRUCTION	0.03	49.73	50.26	0.00	0.10	3.56	90.08	6.35
CONSUMER GOODS	0.08	28.37	47.68	23.93	0.10	19.29	45.23	35.47
ELECTRONICS	0.05	18.85	42.32	38.81	0.05	43.02	12.81	44.15
FOOD AND BEVERAGE	0.02	0.06	47.54	52.38	0.01	1.74	19.98	78.27
FOREST PRODUCTS	0.08	2.84	67.47	29.68	0.03	7.98	7.89	84.11
MACHINERY	0.08	13.75	45.16	41.08	0.13	34.43	41.50	24.05
METALS	0.12	0.49	52.44	47.06	0.11	1.60	35.90	62.48
NON-BANK FINANCE	0.03	15.61	50.87	33.50	0.01	9.85	11.05	79.08
OFFICE EQUIPMENT	0.11	1.32	84.61	14.06	0.07	49.86	37.38	12.74
PETROLEUM REFINING	0.08	5.81	59.53	34.65	0.09	50.76	11.64	37.59
PUBLISHING AND PRINT	0.01	12.32	40.14	47.53	0.02	0.03	60.66	39.30
REAL ESTATE	0.06	0.05	65.54	34.39	0.07	6.90	51.69	41.40
RESTAURANTS AND SPEC TRADE	0.03	1.88	37.24	60.87	0.02	13.67	21.54	64.78
RETAIL TRADE	0.03	3.12	43.84	53.02	0.03	35.70	6.49	57.80
RUBBER, PLASTIC, AND LEATHER	0.07	11.78	67.98	20.22	0.04	0.09	57.55	42.34
SERVICE	0.13	0.17	87.27	12.54	0.06	11.28	21.74	66.97
SOCIAL SERVICES	0.02	64.72	1.44	33.82	0.42	2.27	79.75	17.96
STONE,CLAY,GLASS, AND CONCRETE	0.10	10.80	52.61	36.58	0.07	18.98	31.11	49.90
TEXTILES	0.12	1.34	80.81	17.84	0.05	16.74	1.52	81.72
TRANSPORTATION	0.12	5.62	66.24	28.12	0.05	7.65	19.27	73.06
TRANSPORTATION EQUIP	0.11	7.31	69.20	23.48	0.09	3.56	70.76	25.67
UTILITIES	0.04	0.08	58.28	41.62	0.03	10.34	34.07	55.57
WHOLESALE TRADE	0.09	4.39	54.03	41.57	0.07	29.27	16.98	53.74

INDUSTRY	HB1 MSFE	HB1 BIAS (%)	HB1 INEFFI-CIENCY (%)	HB1 RANDOM (%)	HB2 MSFE	HB2 BIAS (%)	HB2 INEFFI-CIENCY (%)	HB2 RANDOM (%)
AGRICULTURE AND MINING	0.08	4.64	27.86	67.49	0.07	5.21	14.39	80.39
BANKING	0.04	41.74	1.53	56.72	0.04	41.17	1.33	57.49
CHEMICALS AND DRUGS	0.04	1.14	9.75	89.09	0.04	1.97	10.09	87.93
COMMUNICATIONS	0.00	27.74	6.76	65.48	0.01	5.59	13.87	80.52
CONSTRUCTION	0.02	9.38	21.95	68.65	0.04	18.54	0.22	81.22
CONSUMER GOODS	0.06	9.32	2.45	88.21	0.06	4.87	5.92	89.20
ELECTRONICS	0.02	12.09	3.46	84.44	0.03	11.01	14.25	74.73
FOOD AND BEVERAGE	0.02	41.70	3.48	54.80	0.02	28.82	20.22	50.95
FOREST PRODUCTS	0.02	0.06	0.38	99.55	0.03	0.06	33.66	66.26
MACHINERY	0.05	18.03	1.44	80.51	0.05	12.78	10.42	76.78
METALS	0.08	0.70	0.58	98.71	0.08	3.43	0.05	96.51
NON-BANK FINANCE	0.01	27.02	6.60	66.36	0.02	23.26	17.17	59.55
OFFICE EQUIPMENT	0.01	5.40	32.40	62.18	0.00	0.25	0.46	99.27
PETROLEUM REFINING	0.04	15.65	1.78	82.55	0.05	6.15	23.74	70.10
PUBLISHING AND PRINT	0.03	19.21	57.46	23.32	0.03	33.91	41.84	24.23
REAL ESTATE	0.03	1.34	9.93	88.71	0.04	0.00	15.77	84.21
RESTAURANTS AND SPEC TRADE	0.02	0.01	21.97	78.01	0.02	1.97	1.46	96.55
RETAIL TRADE	0.01	0.24	0.05	99.69	0.01	3.68	0.03	96.27
RUBBER, PLASTIC, AND LEATHER	0.02	7.55	1.00	91.44	0.03	20.75	2.55	76.69
SERVICE	0.04	0.10	1.67	98.22	0.04	1.90	2.37	95.72
SOCIAL SERVICES	0.27	21.82	1.84	76.33	0.28	26.90	0.62	72.47
STONE,CLAY,GLASS, AND CONCRETE	0.05	2.69	21.88	75.42	0.04	3.26	11.72	85.01
TEXTILES	0.04	5.05	1.28	93.66	0.04	6.09	0.08	93.81
TRANSPORTATION	0.11	7.14	3.92	88.93	0.11	11.11	0.26	88.62
TRANSPORTATION EQUIP	0.05	8.13	3.10	88.76	0.06	8.49	30.30	61.19
UTILITIES	0.02	24.40	8.74	66.85	0.03	26.11	13.38	60.49
WHOLESALE TRADE	0.09	0.54	13.51	85.94	0.09	0.46	18.60	80.93

INDUSTRY	HB3 MSFE	HB3 BIAS (%)	HB3 INEFFI-CIENCY (%)	HB3 RANDOM (%)	HB4 MSFE	HB4 BIAS (%)	HB4 INEFFI-CIENCY (%)	HB4 RANDOM (%)
AGRICULTURE AND MINING	0.11	2.56	45.69	51.74	0.06	1.04	0.05	98.89
BANKING	0.06	31.65	25.38	42.95	0.04	40.43	0.83	58.73
CHEMICALS AND DRUGS	0.07	5.16	43.88	50.94	0.04	0.29	9.47	90.22
COMMUNICATIONS	0.03	45.37	11.60	43.01	0.00	37.16	2.12	60.70
CONSTRUCTION	0.10	0.05	99.46	0.47	0.02	13.43	14.87	71.68
CONSUMER GOODS	0.08	0.22	32.62	67.14	0.06	11.03	4.69	84.27
ELECTRONICS	0.04	8.13	37.31	54.55	0.03	17.85	6.02	76.12
FOOD AND BEVERAGE	0.04	28.35	43.58	28.06	0.02	38.71	5.10	56.18
FOREST PRODUCTS	0.06	2.09	60.22	37.68	0.02	0.00	0.00	99.98
MACHINERY	0.09	5.12	49.27	45.60	0.05	18.01	3.62	78.35
METALS	0.12	3.26	26.90	69.82	0.08	0.66	2.11	97.21
NON-BANK FINANCE	0.01	12.37	25.27	62.34	0.01	15.74	11.26	72.98
OFFICE EQUIPMENT	0.01	2.18	27.15	70.66	0.01	15.19	23.26	61.53
PETROLEUM REFINING	0.10	6.92	58.40	34.66	0.04	16.77	0.66	82.55
PUBLISHING AND PRINT	0.11	24.43	67.30	8.25	0.03	14.57	58.16	27.26
REAL ESTATE	0.05	1.14	27.38	71.47	0.03	1.03	6.15	92.81
RESTAURANTS AND SPEC TRADE	0.03	0.18	43.79	56.01	0.02	0.00	17.58	82.40
RETAIL TRADE	0.01	13.02	1.12	85.85	0.01	0.05	2.83	97.10
RUBBER, PLASTIC, AND LEATHER	0.05	8.27	45.91	45.81	0.02	5.13	0.15	94.71
SERVICE	0.07	10.52	24.21	65.26	0.04	0.01	3.55	96.42
SOCIAL SERVICES	0.33	19.52	11.38	69.08	0.28	20.18	6.95	72.86
STONE,CLAY,GLASS, AND CONCRETE	0.05	4.80	19.90	75.28	0.05	3.04	17.32	79.63
TEXTILES	0.05	3.56	16.13	80.29	0.05	7.01	10.19	82.78
TRANSPORTATION	0.15	4.01	17.45	78.53	0.10	3.82	1.21	94.95
TRANSPORTATION EQUIP	0.07	4.78	38.74	56.47	0.04	6.11	3.32	90.56
UTILITIES	0.03	21.83	22.13	56.02	0.02	23.60	8.12	68.27
WHOLESALE TRADE	0.13	6.23	33.14	60.62	0.09	0.56	13.57	85.86

INDUSTRY	H1 MSFE	H1 BIAS (%)	H1 INEFFICIENCY (%)	H1 RANDOM (%)	H2 MSFE	H2 BIAS (%)	H2 INEFFICIENCY (%)	H2 RANDOM (%)
AGRICULTURE AND MINING	0.07	0.54	28.73	70.72	0.08	0.56	40.11	59.31
BANKING	0.04	28.32	38.16	33.51	0.04	27.15	40.22	32.62
CHEMICALS AND DRUGS	0.02	1.60	24.35	74.04	0.03	1.69	30.79	67.51
COMMUNICATIONS	0.02	16.50	18.52	64.96	0.02	17.00	28.68	54.31
CONSTRUCTION	0.04	31.12	59.61	9.25	0.04	22.77	77.22	0.00
CONSUMER GOODS	0.06	16.57	16.82	66.60	0.07	12.47	23.73	63.78
ELECTRONICS	0.04	21.76	15.70	62.52	0.04	24.01	13.56	62.41
FOOD AND BEVERAGE	0.02	22.64	19.15	58.19	0.02	21.60	27.15	51.24
FOREST PRODUCTS	0.03	2.81	39.17	58.01	0.03	2.12	31.89	65.98
MACHINERY	0.08	37.45	37.68	24.86	0.09	36.37	32.08	31.54
METALS	0.06	4.35	34.26	61.38	0.06	3.47	34.25	62.27
NON-BANK FINANCE	0.01	11.11	37.17	51.71	0.01	13.22	35.42	51.34
OFFICE EQUIPMENT	0.02	20.35	42.70	36.94	0.02	17.60	53.90	28.48
PETROLEUM REFINING	0.08	48.51	23.34	28.14	0.08	47.36	20.47	32.16
PUBLISHING AND PRINT	0.02	29.72	35.46	34.81	0.02	26.07	42.60	31.31
REAL ESTATE	0.08	6.21	42.16	51.61	0.06	1.57	53.74	44.68
RESTAURANTS AND SPEC TRADE	0.02	6.55	56.08	37.36	0.02	4.12	47.77	48.09
RETAIL TRADE	0.02	0.27	39.61	60.10	0.02	0.10	34.84	65.04
RUBBER, PLASTIC, AND LEATHER	0.02	0.38	65.86	33.74	0.02	0.02	68.32	31.65
SERVICE	0.06	0.11	29.74	70.13	0.06	0.01	57.75	42.22
SOCIAL SERVICES	0.03	13.74	42.65	43.59	0.03	7.86	54.06	38.07
STONE,CLAY,GLASS, AND CONCRETE	0.06	10.34	41.29	48.36	0.05	7.99	38.89	53.10
TEXTILES	0.02	0.59	14.83	84.57	0.06	6.51	58.56	34.91
TRANSPORTATION	0.04	4.94	24.62	70.43	0.14	1.39	24.89	73.71
TRANSPORTATION EQUIP	0.05	2.54	42.03	55.42	0.05	0.15	47.41	52.42
UTILITIES	0.02	10.49	29.29	60.21	0.02	11.83	23.50	64.66
WHOLESALE TRADE	0.10	0.14	54.35	45.49	0.09	0.01	38.84	61.14

INDUSTRY	LOIBES MSFE	LOIBES BIAS (%)	LOIBES INEFFI-CIENCY (%)	LOIBES RANDOM (%)	HIIBES MSFE	HIIBES BIAS (%)	HIIBES INEFFI-CIENCY (%)	HIIBES RANDOM (%)
AGRICULTURE AND MINING	0.06	16.97	0.24	82.78	0.10	32.40	9.34	58.25
BANKING	0.03	12.88	7.57	79.54	0.03	1.37	20.67	77.95
CHEMICALS AND DRUGS	0.04	4.96	9.27	85.76	0.05	25.47	1.70	72.81
COMMUNICATIONS	0.04	42.19	40.83	16.97	0.09	46.39	49.45	4.14
CONSTRUCTION	0.05	0.63	6.93	92.42	0.04	30.33	57.86	11.80
CONSUMER GOODS	0.09	31.01	10.25	58.72	0.31	32.85	50.10	17.04
ELECTRONICS	0.05	47.76	1.85	50.38	0.08	62.37	7.56	30.05
FOOD AND BEVERAGE	0.01	0.95	8.79	90.25	0.01	3.91	21.20	74.87
FOREST PRODUCTS	0.03	8.84	5.11	86.04	0.07	51.23	13.86	34.89
MACHINERY	0.09	46.87	8.02	45.09	0.13	60.54	8.35	31.10
METALS	0.08	2.30	0.33	97.36	0.10	14.23	3.18	82.58
NON-BANK FINANCE	0.01	1.43	0.01	98.54	0.01	9.03	6.19	84.76
OFFICE EQUIPMENT	0.03	43.40	15.15	41.43	0.04	56.35	16.60	27.03
PETROLEUM REFINING	0.07	42.52	4.17	53.30	0.11	57.70	15.58	26.70
PUBLISHING AND PRINT	0.01	0.84	50.67	48.48	0.01	5.10	37.65	57.23
REAL ESTATE	0.06	13.87	33.28	52.84	0.06	26.06	13.56	60.37
RESTAURANTS AND SPEC TRADE	0.02	4.22	17.05	78.71	0.02	25.67	1.27	73.04
RETAIL TRADE	0.02	18.48	0.08	81.43	0.02	45.21	5.48	49.29
RUBBER, PLASTIC, AND LEATHER	0.03	1.71	27.74	70.54	0.02	42.75	0.49	56.74
SERVICE	0.06	4.46	56.45	39.08	0.07	14.84	34.76	50.38
SOCIAL SERVICES	0.23	5.90	1.12	92.97	0.24	0.71	24.66	74.62
STONE,CLAY,GLASS, AND CONCRETE	0.05	14.15	8.34	77.50	0.09	43.63	19.79	36.56
TEXTILES	0.08	15.76	48.55	35.68	0.08	26.60	35.19	38.19
TRANSPORTATION	0.11	0.23	10.47	89.28	0.11	7.44	3.03	89.51
TRANSPORTATION EQUIP	0.04	0.87	6.20	92.91	0.42	13.53	77.84	8.62
UTILITIES	0.02	10.58	22.43	66.97	0.02	1.23	17.31	81.44
WHOLESALE TRADE	0.08	5.97	0.95	93.07	0.09	13.21	0.00	86.77

INDUSTRY	MNIBES				MDIBES			
	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)
AGRICULTURE AND MINING	0.07	25.23	2.17	72.58	0.07	25.04	1.94	73.01
BANKING	0.03	7.35	9.18	83.45	0.03	7.93	8.14	83.92
CHEMICALS AND DRUGS	0.04	13.42	2.50	84.07	0.04	12.53	5.08	82.38
COMMUNICATIONS	0.06	45.42	47.60	6.96	0.07	44.45	49.45	6.09
CONSTRUCTION	0.05	5.99	0.01	93.99	0.06	3.82	76.64	19.52
CONSUMER GOODS	0.11	39.77	12.60	47.61	0.10	38.61	9.76	51.61
ELECTRONICS	0.06	55.75	4.08	40.16	0.06	54.53	4.73	40.73
FOOD AND BEVERAGE	0.01	0.26	13.66	86.07	0.01	0.20	13.73	86.05
FOREST PRODUCTS	0.04	32.72	0.75	66.51	0.03	29.19	0.22	70.57
MACHINERY	0.10	53.76	8.50	37.72	0.10	52.96	8.49	38.54
METALS	0.09	7.14	0.58	92.27	0.08	7.05	0.90	92.04
NON-BANK FINANCE	0.01	1.10	0.00	98.89	0.01	1.29	0.10	98.60
OFFICE EQUIPMENT	0.04	50.06	26.55	23.37	0.04	48.82	29.94	21.23
PETROLEUM REFINING	0.09	51.45	10.62	37.92	0.09	51.79	10.28	37.92
PUBLISHING AND PRINT	0.01	0.18	42.97	56.84	0.01	0.11	41.37	58.51
REAL ESTATE	0.06	18.27	23.96	57.76	0.06	17.35	26.22	56.41
RESTAURANTS AND SPEC TRADE	0.02	13.25	1.80	84.94	0.02	12.28	3.13	84.58
RETAIL TRADE	0.02	32.12	3.99	63.88	0.02	30.66	2.03	67.30
RUBBER, PLASTIC, AND LEATHER	0.03	11.14	2.22	86.63	0.03	8.94	12.44	78.61
SERVICE	0.07	8.71	46.05	45.22	0.07	8.15	46.20	45.63
SOCIAL SERVICES	0.23	2.00	16.12	81.86	0.23	1.84	14.21	83.93
STONE,CLAY,GLASS, AND CONCRETE	0.06	28.16	5.82	66.00	0.05	27.47	0.13	72.38
TEXTILES	0.08	20.47	45.64	33.87	0.08	19.52	45.72	34.74
TRANSPORTATION	0.11	0.71	3.52	95.75	0.11	0.34	9.83	89.82
TRANSPORTATION EQUIP	0.04	18.33	3.46	78.20	0.04	8.69	0.56	90.74
UTILITIES	0.02	5.49	17.51	76.98	0.02	5.97	17.97	76.05
WHOLESALE TRADE	0.08	9.26	1.04	89.69	0.08	9.12	0.36	90.50
	VLGE				VLGD			
UTILITIES	0.01	1.60	0.39	97.99	0.01	3.34	0.17	96.47

APPENDIX 7

DECOMPOSITION OF FORECAST ERROR:
DECOMPOSED BY BIAS, EFFICIENCY, AND RANDOM ERROR.
FORECAST ERRORS ASSESSED AGAINST ACTUAL DIVIDEND GROWTH

INDUSTRY	HD1				HD2			
	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)
AGRICULTURE AND MINING	0.04	1.17	65.83	32.98	0.07	16.94	26.56	56.48
BANKING	0.00	8.30	57.14	34.54	0.01	1.30	59.48	39.20
CHEMICALS AND DRUGS	0.01	18.41	40.22	41.36	0.01	15.28	33.57	51.14
COMMUNICATIONS	NMF	0.00	50.00	50.00	0.02	65.27	32.98	1.73
CONSTRUCTION	0.01	79.37	20.62	0.00	0.04	73.41	0.26	26.32
CONSUMER GOODS	0.01	62.65	2.60	34.74	0.02	54.05	22.03	23.91
ELECTRONICS	0.02	12.54	55.36	32.09	0.02	14.47	46.50	39.02
FOOD AND BEVERAGE	0.00	9.53	12.69	77.76	0.00	12.97	16.61	70.41
FOREST PRODUCTS	0.01	60.01	11.22	28.76	0.01	62.03	6.52	31.44
MACHINERY	0.03	40.38	23.01	36.60	0.05	43.63	25.39	30.97
METALS	0.02	60.72	15.24	24.02	0.03	55.53	16.14	28.31
NON-BANK FINANCE	0.02	10.75	54.43	34.80	0.01	27.03	40.94	32.01
OFFICE EQUIPMENT	0.04	60.26	31.34	8.39	0.02	61.07	16.21	22.71
PETROLEUM REFINING	0.01	69.79	11.85	18.35	0.03	38.10	38.19	23.70
PUBLISHING AND PRINT	0.00	9.90	20.84	69.25	0.00	4.37	33.20	62.42
REAL ESTATE	0.06	3.06	86.32	10.60	0.06	32.50	45.95	21.54
RESTAURANTS AND SPEC TRADE	0.03	4.24	79.98	15.77	0.02	3.39	75.68	20.92
RETAIL TRADE	0.01	31.09	45.91	22.99	0.01	14.15	25.27	60.57
RUBBER, PLASTIC, AND LEATHER	0.01	39.72	31.40	28.87	0.04	23.40	34.81	41.78
SERVICE	0.02	70.15	20.32	9.52	0.04	38.58	41.18	20.22
SOCIAL SERVICES	0.01	96.61	0.35	3.02	0.03	57.49	12.48	30.01
STONE,CLAY,GLASS, AND CONCRETE	0.02	28.55	41.98	29.45	0.02	35.89	8.57	55.53
TEXTILES	0.01	3.09	44.99	51.90	0.02	0.09	61.12	38.78
TRANSPORTATION	0.01	18.01	14.52	67.45	0.03	42.15	7.90	49.94
TRANSPORTATION EQUIP	0.02	14.04	47.94	38.01	0.03	14.15	58.96	26.88
UTILITIES	0.00	0.78	14.37	84.84	0.00	3.41	15.45	81.12
WHOLESALE TRADE	0.01	26.40	32.75	40.84	0.02	46.96	1.71	51.32

INDUSTRY	HD3 MSFE	HD3 BIAS (%)	HD3 INEFFI-CIENCY (%)	HD3 RANDOM (%)	HD4 MSFE	HD4 BIAS (%)	HD4 INEFFI-CIENCY (%)	HD4 RANDOM (%)
AGRICULTURE AND MINING	0.06	23.04	31.85	45.10	0.08	52.32	7.72	39.95
BANKING	0.02	7.53	57.23	35.22	0.01	0.26	61.54	38.18
CHEMICALS AND DRUGS	0.01	10.46	55.71	33.82	0.01	25.08	34.52	40.39
COMMUNICATIONS	0.00	26.52	72.47	1.00	0.01	84.13	12.01	3.85
CONSTRUCTION	0.04	48.97	9.87	41.15	0.08	64.68	34.45	0.86
CONSUMER GOODS	0.01	50.23	22.29	27.47	0.03	55.95	23.22	20.82
ELECTRONICS	0.02	4.41	48.02	47.55	0.02	17.41	46.16	36.41
FOOD AND BEVERAGE	0.01	16.26	43.13	40.59	0.00	19.77	16.79	63.42
FOREST PRODUCTS	0.01	41.87	34.37	23.74	0.02	64.71	11.03	24.24
MACHINERY	0.07	25.88	50.22	23.89	0.05	59.12	16.11	24.76
METALS	0.02	41.47	28.63	29.89	0.03	67.39	10.54	22.05
NON-BANK FINANCE	0.01	2.51	54.01	43.46	0.02	34.09	38.64	27.25
OFFICE EQUIPMENT	0.03	48.44	40.76	10.79	0.04	72.31	18.86	8.81
PETROLEUM REFINING	0.04	39.95	39.82	20.21	0.02	61.72	4.13	34.14
PUBLISHING AND PRINT	0.02	0.84	66.48	32.66	0.00	18.60	19.16	62.22
REAL ESTATE	0.03	8.12	60.90	30.97	0.03	1.43	75.90	22.65
RESTAURANTS AND SPEC TRADE	0.03	14.37	70.74	14.87	0.02	2.67	75.71	21.61
RETAIL TRADE	0.01	1.75	39.71	58.52	0.01	31.41	29.94	38.64
RUBBER, PLASTIC, AND LEATHER	0.03	18.10	30.32	51.57	0.05	26.83	38.09	35.07
SERVICE	0.03	14.43	65.17	20.38	0.03	52.60	23.93	23.45
SOCIAL SERVICES	0.01	49.60	12.24	38.15	0.03	83.58	2.57	13.84
STONE,CLAY,GLASS, AND CONCRETE	0.01	36.21	1.63	62.14	0.03	40.56	27.94	31.48
TEXTILES	0.03	2.13	71.47	26.38	0.01	3.65	46.23	50.11
TRANSPORTATION	0.06	35.21	40.28	24.49	0.04	38.74	18.43	42.82
TRANSPORTATION EQUIP	0.02	2.39	59.88	37.71	0.03	35.18	29.28	35.52
UTILITIES	0.00	8.90	36.16	54.92	0.00	3.77	23.93	72.28
WHOLESALE TRADE	0.03	38.94	16.28	44.77	0.03	43.47	10.27	46.25

INDUSTRY	HE1 MSFE	HE1 BIAS (%)	HE1 INEFFI-CIENCY (%)	HE1 RANDOM (%)	HE2 MSFE	HE2 BIAS (%)	HE2 INEFFI-CIENCY (%)	HE2 RANDOM (%)
AGRICULTURE AND MINING	0.10	4.53	57.73	37.73	0.07	7.78	34.75	57.45
BANKING	0.01	2.29	34.91	62.79	0.01	14.74	26.91	58.33
CHEMICALS AND DRUGS	0.01	12.45	34.89	52.65	0.01	2.44	60.05	37.50
COMMUNICATIONS	0.02	51.95	44.82	3.21	0.02	28.33	68.64	3.02
CONSTRUCTION	0.11	42.11	45.73	12.14	0.04	18.05	35.99	45.94
CONSUMER GOODS	0.01	34.72	36.68	28.58	0.02	0.61	78.59	20.79
ELECTRONICS	0.01	22.07	25.69	52.23	0.01	2.09	49.87	48.02
FOOD AND BEVERAGE	0.00	28.14	16.89	54.96	0.00	13.77	28.56	57.66
FOREST PRODUCTS	0.01	41.63	23.11	35.25	0.01	6.32	56.63	37.03
MACHINERY	0.05	49.37	25.88	24.73	0.05	37.63	35.04	27.32
METALS	0.01	56.28	11.92	31.79	0.01	10.34	54.46	35.19
NON-BANK FINANCE	0.00	6.52	22.21	71.25	0.01	0.07	43.92	55.99
OFFICE EQUIPMENT	0.02	67.41	12.79	19.79	0.01	46.58	2.34	51.06
PETROLEUM REFINING	0.03	63.19	21.12	15.68	0.04	38.16	49.06	12.77
PUBLISHING AND PRINT	0.00	7.48	21.34	71.17	0.01	0.41	50.28	49.30
REAL ESTATE	0.03	2.04	64.00	33.94	0.07	13.28	66.55	20.15
RESTAURANTS AND SPEC TRADE	0.00	1.04	32.76	66.19	0.00	6.58	32.21	61.20
RETAIL TRADE	0.01	6.84	3.37	89.77	0.00	4.65	6.21	89.12
RUBBER, PLASTIC, AND LEATHER	0.04	21.52	36.90	41.56	0.03	14.44	35.52	50.03
SERVICE	0.01	23.83	29.46	46.69	0.02	5.99	54.89	39.11
SOCIAL SERVICES	0.01	53.36	0.00	46.62	0.01	58.50	10.47	31.01
STONE,CLAY,GLASS, AND CONCRETE	0.02	29.98	23.02	46.98	0.02	21.83	36.23	41.93
TEXTILES	0.01	3.34	31.94	64.71	0.02	3.57	51.08	45.33
TRANSPORTATION	0.03	32.03	17.88	50.07	0.03	19.89	27.29	52.80
TRANSPORTATION EQUIP	0.03	11.75	55.62	32.62	0.04	0.00	79.95	20.03
UTILITIES	0.00	0.10	24.72	75.16	0.00	0.63	42.03	57.32
WHOLESALE TRADE	0.02	35.91	9.80	54.27	0.03	17.12	31.64	51.22

INDUSTRY	HE3				HE4			
	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)
AGRICULTURE AND MINING	0.08	0.21	53.78	45.99	0.08	54.54	2.83	42.61
BANKING	0.02	0.00	69.33	30.66	0.01	5.43	39.87	54.68
CHEMICALS AND DRUGS	0.02	1.12	81.23	17.63	0.01	18.15	32.83	49.01
COMMUNICATIONS	0.06	5.69	92.06	2.24	0.00	78.26	19.44	2.29
CONSTRUCTION	0.02	52.15	22.39	25.45	0.12	55.09	34.90	9.99
CONSUMER GOODS	0.04	1.33	88.01	10.65	0.01	39.99	32.19	27.80
ELECTRONICS	0.03	0.81	74.95	24.22	0.01	25.72	24.44	49.82
FOOD AND BEVERAGE	0.01	15.70	58.07	26.22	0.00	36.88	6.25	56.86
FOREST PRODUCTS	0.03	7.45	78.42	14.11	0.01	62.69	2.44	34.85
MACHINERY	0.05	13.08	67.89	19.01	0.05	48.45	23.17	28.36
METALS	0.04	0.00	85.30	14.69	0.02	63.57	6.27	30.15
NON-BANK FINANCE	0.02	4.40	71.69	23.90	0.01	34.65	13.38	51.96
OFFICE EQUIPMENT	0.10	3.61	91.85	4.53	0.04	72.55	15.14	12.30
PETROLEUM REFINING	0.06	15.04	76.42	8.52	0.03	62.11	15.86	22.01
PUBLISHING AND PRINT	0.01	0.08	63.89	36.02	0.00	12.81	23.22	63.95
REAL ESTATE	0.07	1.14	82.25	16.59	0.04	11.98	51.92	36.09
RESTAURANTS AND SPEC TRADE	0.01	34.52	39.85	25.61	0.01	0.00	50.33	49.66
RETAIL TRADE	0.02	0.51	62.00	37.47	0.01	13.28	21.79	64.91
RUBBER, PLASTIC, AND LEATHER	0.04	47.28	29.36	23.34	0.04	25.36	35.44	39.18
SERVICE	0.05	0.70	82.06	17.23	0.02	38.73	20.05	41.20
SOCIAL SERVICES	0.02	23.22	60.21	16.56	0.02	14.57	47.93	37.48
STONE,CLAY,GLASS, AND CONCRETE	0.03	11.77	52.89	35.33	0.03	42.64	21.69	35.66
TEXTILES	0.07	13.51	77.09	9.38	0.02	2.22	58.64	39.12
TRANSPORTATION	0.06	0.00	69.14	30.84	0.04	43.50	9.79	46.69
TRANSPORTATION EQUIP	0.07	8.52	76.28	15.18	0.03	25.97	47.52	26.50
UTILITIES	0.03	9.51	80.99	9.49	0.00	0.04	22.23	77.71
WHOLESALE TRADE	0.06	3.31	73.32	23.36	0.03	50.43	2.76	46.79

INDUSTRY	HB1 MSFE	HB1 BIAS (%)	HB1 INEFFI-CIENCY (%)	HB1 RANDOM (%)	HB2 MSFE	HB2 BIAS (%)	HB2 INEFFI-CIENCY (%)	HB2 RANDOM (%)
AGRICULTURE AND MINING	0.05	1.86	12.59	85.53	0.04	5.01	10.80	84.17
BANKING	0.01	11.50	2.05	86.43	0.00	13.09	3.58	83.32
CHEMICALS AND DRUGS	0.00	5.51	17.19	77.29	0.01	7.23	33.49	59.27
COMMUNICATIONS	0.00	3.29	71.17	25.52	0.00	3.41	73.25	23.33
CONSTRUCTION	0.04	22.39	27.63	49.97	0.04	9.74	45.06	45.18
CONSUMER GOODS	0.00	0.29	28.38	71.32	0.01	0.28	48.02	51.68
ELECTRONICS	0.01	6.37	20.94	72.67	0.02	10.36	40.18	49.45
FOOD AND BEVERAGE	0.00	28.64	12.99	58.36	0.01	17.77	36.24	45.98
FOREST PRODUCTS	0.00	2.13	28.89	68.97	0.01	0.75	56.29	42.95
MACHINERY	0.02	5.65	16.33	78.01	0.03	0.64	51.96	47.38
METALS	0.01	8.18	13.33	78.48	0.01	0.15	38.70	61.13
NON-BANK FINANCE	0.00	14.76	10.07	75.16	0.00	9.53	22.41	68.05
OFFICE EQUIPMENT	0.00	0.01	6.62	93.35	0.01	2.71	58.57	38.70
PETROLEUM REFINING	0.01	0.44	47.00	52.54	0.01	1.53	56.20	42.25
PUBLISHING AND PRINT	0.01	34.44	10.50	55.04	0.02	38.00	34.24	27.75
REAL ESTATE	0.01	11.92	7.24	80.82	0.02	4.47	48.27	47.24
RESTAURANTS AND SPEC TRADE	0.01	36.92	11.72	51.34	0.01	41.37	17.39	41.22
RETAIL TRADE	0.01	10.24	0.83	88.92	0.01	20.35	4.08	75.56
RUBBER, PLASTIC, AND LEATHER	0.02	9.42	7.28	83.28	0.02	1.25	22.54	76.19
SERVICE	0.01	0.14	21.10	78.75	0.01	1.05	21.48	77.46
SOCIAL SERVICES	0.02	36.21	5.14	58.63	0.04	45.36	24.89	29.73
STONE,CLAY,GLASS, AND CONCRETE	0.01	0.93	50.56	48.49	0.02	1.46	38.47	60.06
TEXTILES	0.00	4.77	3.58	91.64	0.00	5.23	8.16	86.60
TRANSPORTATION	80.27	99.97	0.00	0.02	0.02	0.01	33.82	66.16
TRANSPORTATION EQUIP	0.01	2.23	20.49	77.27	0.01	3.17	36.95	59.86
UTILITIES	0.00	20.32	16.09	63.57	0.00	24.80	28.38	46.80
WHOLESALE TRADE	0.02	2.47	28.16	69.35	0.02	0.00	48.04	51.95

INDUSTRY	HB3				HB4			
	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)	MSFE	BIAS (%)	INEFFI-CIENCY (%)	RANDOM (%)
AGRICULTURE AND MINING	0.08	3.15	51.45	45.38	0.04	2.65	5.64	91.70
BANKING	0.02	10.99	60.17	28.83	0.01	6.22	13.89	79.88
CHEMICALS AND DRUGS	0.03	10.50	70.85	18.63	0.00	1.45	22.95	75.59
COMMUNICATIONS	0.07	4.56	94.55	0.88	0.00	6.13	75.52	18.34
CONSTRUCTION	0.04	31.76	17.95	50.27	0.03	17.73	18.68	63.58
CONSUMER GOODS	0.05	5.87	84.06	10.06	0.00	5.10	35.32	59.57
ELECTRONICS	0.03	8.75	66.45	24.78	0.01	3.69	26.69	69.60
FOOD AND BEVERAGE	0.04	10.65	77.49	11.85	0.00	20.90	20.98	58.11
FOREST PRODUCTS	0.03	0.08	80.18	19.72	0.00	3.47	31.68	64.83
MACHINERY	0.06	0.00	73.74	26.25	0.02	6.25	19.44	74.30
METALS	16.06	99.71	0.23	0.05	0.01	7.35	19.71	72.92
NON-BANK FINANCE	0.01	10.49	42.70	46.80	0.00	2.86	2.93	94.20
OFFICE EQUIPMENT	0.03	0.18	85.59	14.21	0.00	11.31	0.43	88.24
PETROLEUM REFINING	0.05	0.00	86.72	13.27	0.01	1.00	48.27	50.71
PUBLISHING AND PRINT	0.09	28.39	65.10	6.50	0.01	25.67	14.26	60.06
REAL ESTATE	0.04	23.43	43.30	33.26	0.01	8.18	9.70	82.11
RESTAURANTS AND SPEC TRADE	0.02	12.63	66.16	21.20	0.01	38.56	11.75	49.68
RETAIL TRADE	0.02	14.26	45.49	40.23	0.01	9.74	2.33	87.91
RUBBER, PLASTIC, AND LEATHER	0.04	0.20	59.60	40.19	0.02	13.05	7.99	78.95
SERVICE	0.04	9.01	69.53	21.45	0.01	1.25	25.28	73.46
SOCIAL SERVICES	0.09	30.11	55.87	14.00	0.02	37.96	4.93	57.09
STONE,CLAY,GLASS, AND CONCRETE	8.79	99.80	0.05	0.13	0.02	0.50	59.16	40.32
TEXTILES	0.03	2.51	70.56	26.91	0.00	2.63	5.59	91.76
TRANSPORTATION	0.07	5.53	73.34	21.12	0.02	9.02	15.76	75.21
TRANSPORTATION EQUIP	0.03	0.75	70.73	28.51	0.01	1.15	25.49	73.34
UTILITIES	0.01	9.57	65.29	25.13	0.00	18.64	18.88	62.47
WHOLESALE TRADE	0.08	7.83	72.34	19.81	0.02	3.84	28.84	67.31

INDUSTRY	H1 MSFE	H1 BIAS (%)	H1 INEFFICIENCY (%)	H1 RANDOM (%)	H2 MSFE	H2 BIAS (%)	H2 INEFFICIENCY (%)	H2 RANDOM (%)
AGRICULTURE AND MINING	0.05	8.37	20.81	70.81	0.06	9.98	21.59	68.41
BANKING	0.01	0.60	33.80	65.58	0.01	0.22	41.57	58.20
CHEMICALS AND DRUGS	0.01	0.36	40.74	58.88	0.01	0.50	46.09	53.40
COMMUNICATIONS	0.00	10.61	52.05	37.33	0.00	13.23	43.98	42.78
CONSTRUCTION	0.05	49.60	0.75	49.63	0.04	44.80	2.00	53.18
CONSUMER GOODS	0.00	15.00	20.44	64.54	0.00	14.78	19.76	65.44
ELECTRONICS	0.00	0.13	14.77	85.09	0.01	0.00	16.61	83.38
FOOD AND BEVERAGE	0.00	6.25	32.39	61.34	0.00	4.07	35.77	60.14
FOREST PRODUCTS	35.55	99.97	0.00	0.01	0.00	12.59	2.81	84.58
MACHINERY	0.03	41.97	10.37	47.65	0.03	43.83	8.92	47.24
METALS	0.01	32.16	14.88	52.95	0.01	31.62	9.06	59.30
NON-BANK FINANCE	0.00	2.37	35.56	62.05	0.00	3.97	25.93	70.09
OFFICE EQUIPMENT	0.01	21.40	70.03	8.55	0.01	19.24	59.53	21.22
PETROLEUM REFINING	0.01	50.12	8.90	40.96	0.01	46.99	10.23	42.77
PUBLISHING AND PRINT	0.01	23.43	34.52	42.04	0.01	19.59	37.27	43.13
REAL ESTATE	0.02	0.92	22.98	76.08	0.01	0.02	21.54	78.43
RESTAURANTS AND SPEC TRADE	0.01	62.31	3.52	34.15	0.01	62.38	0.63	36.97
RETAIL TRADE	0.01	15.95	32.52	51.52	0.01	17.80	24.31	57.88
RUBBER, PLASTIC, AND LEATHER	0.02	12.26	7.58	80.15	0.02	13.97	7.05	78.96
SERVICE	0.01	1.03	41.27	57.69	0.01	1.56	44.87	53.55
SOCIAL SERVICES	0.01	13.43	8.54	78.01	0.01	8.06	6.19	85.74
STONE,CLAY,GLASS, AND CONCRETE	0.01	23.39	3.87	72.73	0.01	19.33	2.20	78.46
TEXTILES	0.01	0.71	24.76	74.51	0.01	1.34	20.52	78.13
TRANSPORTATION	0.03	18.06	27.63	54.30	0.02	18.21	21.77	60.01
TRANSPORTATION EQUIP	0.01	6.17	48.79	45.03	0.01	4.16	54.16	41.67
UTILITIES	0.00	2.29	19.66	78.03	0.00	0.64	18.59	80.75
WHOLESALE TRADE	0.02	8.53	25.55	65.91	0.02	8.39	17.09	74.50

INDUSTRY	LOIBES MSFE	LOIBES BIAS (%)	LOIBES INEFFI-CIENCY (%)	LOIBES RANDOM (%)	HIIBES MSFE	HIIBES BIAS (%)	HIIBES INEFFI-CIENCY (%)	HIIBES RANDOM (%)
AGRICULTURE AND MINING	0.05	23.62	1.01	75.36	0.08	42.66	7.08	50.25
BANKING	0.01	14.64	13.51	71.84	0.02	35.37	19.97	44.64
CHEMICALS AND DRUGS	0.00	27.21	3.30	69.48	0.02	57.45	17.47	25.06
COMMUNICATIONS	0.00	82.18	12.68	5.13	0.04	87.73	10.09	2.17
CONSTRUCTION	0.04	57.78	0.02	42.19	0.08	74.62	3.66	21.70
CONSUMER GOODS	0.02	55.21	21.19	23.58	0.16	35.49	61.57	2.93
ELECTRONICS	0.01	37.24	0.18	62.57	0.03	59.16	12.99	27.83
FOOD AND BEVERAGE	0.00	21.93	1.78	76.28	0.01	47.07	9.48	43.44
FOREST PRODUCTS	0.00	62.48	1.27	36.23	0.06	67.28	23.69	9.02
MACHINERY	0.03	58.11	0.03	41.84	0.07	70.10	7.82	22.06
METALS	0.01	63.15	0.54	36.30	0.03	77.46	0.89	21.63
NON-BANK FINANCE	0.00	6.65	0.00	93.33	0.01	39.82	27.92	32.24
OFFICE EQUIPMENT	0.01	61.28	5.80	32.90	0.02	83.93	1.04	15.02
PETROLEUM REFINING	0.01	39.85	18.12	42.02	0.04	76.07	4.71	19.21
PUBLISHING AND PRINT	0.00	2.99	8.67	88.32	0.01	33.32	9.92	56.75
REAL ESTATE	0.01	15.29	0.30	84.39	0.02	31.43	8.65	59.91
RESTAURANTS AND SPEC TRADE	0.00	1.83	24.14	74.02	0.00	14.93	7.62	77.44
RETAIL TRADE	80.65	99.98	0.00	0.01	0.01	32.07	1.84	66.08
RUBBER, PLASTIC, AND LEATHER	0.02	38.97	0.08	60.93	0.05	59.69	11.79	28.51
SERVICE	0.01	36.98	3.55	59.45	0.04	46.17	34.54	19.27
SOCIAL SERVICES	0.01	24.14	0.01	75.84	0.02	73.08	1.34	25.57
STONE,CLAY,GLASS, AND CONCRETE	0.02	23.57	19.75	56.66	0.08	52.16	32.18	15.65
TEXTILES	0.01	12.26	19.72	68.01	0.01	45.52	6.80	47.66
TRANSPORTATION	0.03	37.23	8.11	54.65	0.07	62.54	14.05	23.40
TRANSPORTATION EQUIP	0.01	28.08	5.39	66.52	0.54	14.84	83.45	1.70
UTILITIES	0.00	0.31	8.63	91.04	0.00	28.44	22.62	48.93
WHOLESALE TRADE	0.02	45.10	1.85	53.03	0.03	60.95	0.25	38.79

INDUSTRY	MNIBES MSFE	MNIBES BIAS (%)	MNIBES INEFFICIENCY (%)	MNIBES RANDOM (%)	MDIBES MSFE	MDIBES BIAS (%)	MDIBES INEFFICIENCY (%)	MDIBES RANDOM (%)
AGRICULTURE AND MINING	0.06	34.19	1.61	64.19	0.06	33.84	1.42	64.73
BANKING	0.01	24.99	11.64	63.36	0.01	24.25	10.74	64.99
CHEMICALS AND DRUGS	0.01	47.17	7.86	44.95	0.01	44.69	9.94	45.35
COMMUNICATIONS	0.01	86.32	10.64	3.03	0.02	81.47	15.37	3.15
CONSTRUCTION	10.23	99.84	0.00	0.15	0.05	68.15	1.46	30.38
CONSUMER GOODS	0.03	71.80	11.71	16.47	0.02	68.36	13.34	18.29
ELECTRONICS	0.02	52.72	2.93	44.34	0.01	52.12	2.39	45.47
FOOD AND BEVERAGE	0.00	37.08	3.44	59.47	0.00	37.08	3.00	59.91
FOREST PRODUCTS	0.02	75.65	2.17	22.16	0.01	76.69	0.42	22.88
MACHINERY	0.04	67.74	0.20	32.05	0.04	66.57	0.17	33.25
METALS	0.02	73.69	0.26	26.03	0.02	74.25	0.26	25.47
NON-BANK FINANCE	0.00	30.57	0.61	68.81	0.00	29.64	0.00	70.35
OFFICE EQUIPMENT	0.01	76.24	0.23	23.51	0.01	75.12	0.01	24.85
PETROLEUM REFINING	0.02	62.13	6.34	31.52	0.02	60.52	7.58	31.89
PUBLISHING AND PRINT	0.00	14.90	6.37	78.72	0.00	14.14	5.77	80.08
REAL ESTATE	15.52	99.91	0.00	0.08	0.01	20.98	0.00	79.01
RESTAURANTS AND SPEC TRADE	0.00	1.30	13.14	85.54	0.00	1.32	15.88	82.78
RETAIL TRADE	0.01	15.16	0.09	84.73	0.01	13.76	0.39	85.83
RUBBER, PLASTIC, AND LEATHER	0.03	54.20	0.05	45.74	0.03	49.42	0.37	50.20
SERVICE	0.02	47.29	10.86	41.83	0.01	47.39	3.59	49.00
SOCIAL SERVICES	0.01	66.57	15.27	18.15	0.01	67.31	10.86	21.81
STONE,CLAY,GLASS, AND CONCRETE	0.03	46.64	14.67	38.68	0.02	45.57	7.88	46.53
TEXTILES	0.01	28.93	8.64	62.41	0.01	26.94	9.28	63.77
TRANSPORTATION	0.04	52.33	10.05	37.61	0.04	50.55	9.98	39.46
TRANSPORTATION EQUIP	0.03	43.83	33.14	23.01	0.02	48.87	7.20	43.92
UTILITIES	0.01	10.94	12.77	76.28	0.01	9.20	13.60	77.19
WHOLESALE TRADE	0.03	54.03	0.13	45.83	0.03	53.43	0.37	46.19
	VLGE				VLGD			
UTILITIES	0.01	15.92	45.39	38.68	0.01	34.47	17.77	47.74

APPENDIX 8

ACCURACY OF FORECASTS BY HISTORICAL METHODS VERSUS IBES FORECASTS.
WILCOXON SIGNED RANKS: ERRORS ASSESSED AGAINST ACTUAL EARNINGS GROWTH

AGRICULTURE AND MINING

HD1	1.60811	32	0.07480	32	0.50487	32	0.63576	32
HD2	1.55201	32	-1.47410	33	0.70578	33	0.79512	33
HD3	0.35048	34	-1.54724	34	-0.07693	34	-0.45306	34
HD4	2.20263 *	20	0.67199	20	1.94130	20	1.97863 *	20
HE1	1.15977	41	-1.25048	41	0.01944	41	0.13606	41
HE2	0.83581	41	-1.75586	41	-0.18790	41	-0.05831	41
HE3	1.47410	33	0.59857	33	1.59917	33	1.56344	33
HE4	1.77143	24	0.40000	24	0.97143	24	1.22857	24
HB1	-1.05939	49	-2.11380 *	49	-1.67612	49	-1.61644	49
HB2	-1.34393	47	-2.55388 *	48	-1.73336	48	-1.55900	48
HB3	0.57002	45	-0.33298	45	0.41200	45	0.41200	45
HB4	-2.01914 *	26	-1.91755	26	-1.14354	25	-1.15561	26
H1	0.66895	42	-0.67620	43	-0.95392	43	-0.79695	43
H2	0.55173	46	-1.84093	46	-1.26985	45	-1.12311	45

BANKING

HD1	2.61117 **	49	1.76565	49	2.87974 **	49	2.94937 **	49
HD2	2.65269 **	51	1.80999	50	3.32556 **	50	3.51637 **	49
HD3	1.98449 *	49	0.83501	50	2.21327 *	49	2.46196 *	49
HD4	2.83001 **	49	2.11285 *	48	3.28210 **	48	3.39492 **	48
HE1	2.64017 **	50	1.02171	51	2.84289 **	50	2.89116 **	50
HE2	-0.14424	49	-0.63229	50	0.32329	49	0.28477	50
HE3	2.26301 *	49	1.42744	49	2.15359 *	49	2.20333 *	49
HE4	1.39665	51	0.83424	51	2.58225 **	50	2.75043 **	49
HB1	3.23868 **	50	2.61520 **	51	3.44944 **	51	3.48693 **	51
HB2	2.09028 *	51	1.73409	51	2.82141 **	51	2.84953 **	51
HB3	1.01842	50	1.30291	51	2.45201 *	49	2.44711 *	50
HB4	2.81204 **	51	2.29650 *	51	3.26197 **	51	3.36508 **	51
H1	3.92748 **	51	2.08091 *	51	3.42209 **	50	3.48966 **	50
H2	4.40553 **	51	2.22151 *	51	3.71189 **	51	3.81500 **	51

Positive values indicate superiority of IBES method. An "*" indicates significance at the .05 level, an "**" indicates significance at the .01 level.

				CHEMICALS AND DRUGS				
HD1	1.56998	59	-1.30459	58	0.27485	58	0.26418	59
HD2	-0.21349	60	-1.84742	62	-1.09538	63	-0.77361	63
HD3	2.03632 *	61	-1.70019	62	0.32601	62	0.15775	62
HD4	2.48165 *	61	-0.48026	62	0.86587	62	0.80978	62
HE1	1.57753	59	-2.56255 *	62	-0.52793	61	-0.65004	61
HE2	-0.44138	64	-3.55775 **	64	-2.10860 *	63	-2.17344 *	64
HE3	2.48329 *	59	0.27173	59	1.66848	58	1.61428	58
HE4	1.11592	63	-3.04950 **	64	-0.72894	64	-0.63531	64
HB1	-0.93776	65	-2.91131 **	65	-1.75463	65	-1.79384	65
HB2	-2.35222 *	62	-3.29688 **	65	-2.55189 *	65	-2.58138 **	64
HB3	1.26653	63	-1.32159	62	0.26935	61	0.15074	62
HB4	-1.15995	65	-3.02598 **	63	-1.84845	63	-1.89925	64
H1	-0.73266	62	-3.32721 **	63	-2.16292 *	62	-2.23025 *	61
H2	-0.20063	64	-3.25682 **	64	-2.11325 *	64	-2.15652 *	63
				CONSUMER GOODS				
HD1	1.02233	15	-1.98787 *	15	0.45437	15	0.28398	15
HD2	0.37018	18	-2.21332 *	19	-1.24751	19	-0.36218	19
HD3	0.80484	19	-2.02509 *	18	-1.04630	19	-0.52315	19
HD4	1.03418	16	-1.24101	16	0.72392	16	0.67221	16
HE1	0.64302	21	-1.44244	21	-0.43447	21	-0.81681	21
HE2	-1.02535	21	-1.79002	21	-1.92905	21	-1.79002	21
HE3	-0.87905	16	-0.82734	16	-1.44785	16	-1.39614	16
HE4	3.16540 **	22	-1.02267	22	0.24349	22	1.18500	22
HB1	-1.70445	22	-2.64595 **	22	-2.22390 *	22	-2.15897 *	22
HB2	-1.31486	22	-2.45116 *	22	-2.06157 *	22	-1.89924	22
HB3	0.43829	22	-1.57458	22	-0.85156	21	-0.19117	21
HB4	-1.70445	22	-2.45116 *	22	-2.15897 *	22	-2.06157 *	22
H1	-1.93163	19	-2.61574 **	19	-2.37429 *	19	-2.21332 *	19
H2	-1.19914	21	-2.27663 *	21	-1.92905	21	-1.75526	21

Positive values indicate superiority of IBES method. An "*" indicates significance at the .05 level, an "**" indicates significance at the .01 level.

						ELECTRONICS						
HD1	-0.40203		33	-3.88625	**	33	-1.68851		33	-1.40263		33
HD2	0.20631		42	-3.44476	**	42	-1.80678		42	-1.63923		41
HD3	-0.59167		43	-2.64442	**	43	-1.71464		43	-1.60597		43
HD4	0.87739		38	-2.93671	**	38	-0.73168		37	-0.29418		37
HE1	0.62435		47	-3.33338	**	47	-0.92065		47	-0.79366		47
HE2	-0.39292		49	-3.44674	**	49	-2.02428	*	49	-1.98449	*	49
HE3	0.74865		43	-1.84389		44	-0.37345		44	-0.04668		44
HE4	1.95464		49	-3.17816	**	49	-0.26360		49	-0.02051		48
HB1	-4.34200	**	49	-5.29694	**	49	-4.90899	**	49	-4.87186	**	48
HB2	-2.76038	**	49	-4.74984	**	49	-4.12316	**	49	-4.12316	**	49
HB3	-1.04763		47	-3.71434	**	47	-3.03708	**	47	-2.72594	**	45
HB4	-4.18284	**	49	-5.56551	**	49	-5.07699	**	48	-4.86779	**	47
H1	-3.03179	**	46	-4.50672	**	46	-3.86212	**	46	-3.74182	**	45
H2	-2.22322	*	49	-4.53099	**	49	-3.58600	**	49	-3.47697	**	48
						FOOD AND BEVERAGE						
HD1	-0.15207		23	-1.49033		23	-0.95774		22	-0.92527		22
HD2	0.72996		23	-0.21290		23	0.48664		23	0.30415		23
HD3	0.25714		24	-0.54286		24	0.57143		24	0.80000		24
HD4	0.48664		23	-1.49033		23	0.15207		23	0.06083		23
HE1	1.31429		24	-0.09124		23	1.06452		23	1.00369		23
HE2	0.20000		24	-0.65922		25	0.25562		25	0.28252		25
HE3	1.34733		22	0.51429		24	1.42857		24	1.60000		24
HE4	0.91429		24	0.17489		25	1.03592		25	1.40000		24
HB1	1.08973		25	0.95520		25	1.43952		25	1.42857		24
HB2	0.85714		24	-0.04036		25	0.55159		25	0.55159		25
HB3	0.12166		23	1.18618		23	0.57788		23	0.72996		23
HB4	1.11429		24	0.68613		25	1.18618		23	1.14286		24
H1	1.68571		24	0.74286		24	1.42857		24	1.40000		24
H2	2.25714	*	24	0.97328		23	1.82857		24	1.77143		24

Positive values indicate superiority of IBES method. An "*" indicates significance at the .05 level, an "**" indicates significance at the .01 level.

				FOREST PRODUCTS								
HD1	0.56815		22	-2.67842	**	22	-1.57458		22	-1.02267		22
HD2	-0.39971		21	-3.49772	**	23	-2.55486	*	23	-2.00739	*	23
HD3	-1.41226		22	-2.93814	**	22	-2.67842	**	22	-2.22390	*	22
HD4	0.28571		24	-2.88571	**	24	-1.28571		24	-0.76037		23
HE1	1.65478		25	-1.76240		25	0.06727		25	0.90138		25
HE2	1.25714		24	-2.32745	*	25	-0.73994		25	-0.39015		25
HE3	0.52266		20	-1.11998		20	-0.29866		20	-0.14933		20
HE4	0.76037		23	-3.20000	**	24	-1.60000		24	-1.02857		24
HB1	-0.25562		25	-2.89249	**	25	-1.70859		25	-2.16601	*	25
HB2	-0.11429		24	-3.10775	**	25	-2.27363	*	25	-1.65478		25
HB3	-0.33634		25	-3.16156	**	25	-1.78931		25	-1.49333		25
HB4	-0.57143		24	-3.16156	**	25	-1.97766	*	25	-1.78931		25
H1	-0.92108		21	-3.01108	**	23	-2.61569	**	23	-2.34195	*	23
H2	-1.85531		23	-3.17143	**	24	-2.68571	**	24	-2.48571	*	24
				MACHINERY								
HD1	-0.67305		26	-2.70489	**	26	-2.52710	*	26	-2.42551	*	26
HD2	-0.64868		27	-2.70489	**	26	-1.89798		27	-2.52263	*	27
HD3	-1.32074		28	-2.11774	*	28	-2.14051	*	28	-2.14051	*	28
HD4	0.95242		26	-2.19693	*	26	-1.94295		26	-1.91755		26
HE1	-0.04554		28	-1.73063		28	-1.45737		28	-1.41183		28
HE2	-0.18217		28	-3.18800	**	28	-1.57123		28	-1.50291		28
HE3	-1.06011		21	-0.99059		21	-1.02535		21	-1.75526		21
HE4	1.59405		30	-1.84087		30	-0.21597		30	-0.09256		30
HB1	-3.19424	**	31	-3.70375	**	31	-3.58617	**	31	-3.60576	**	31
HB2	-2.52795	*	31	-3.42940	**	31	-3.21383	**	31	-3.25303	**	31
HB3	-0.89472		30	-2.56076	*	30	-2.02598	*	30	-1.86144		30
HB4	-2.97868	**	31	-3.72334	**	31	-3.58617	**	31	-3.54698	**	31
H1	-1.23180		26	-2.97910	**	27	-3.12325	**	27	-3.09923	**	27
H2	-0.98503		27	-3.66620	**	28	-3.11969	**	28	-2.98306	**	28

Positive values indicate superiority of IBES method. An "*" indicates significance at the .05 level, an "**" indicates significance at the .01 level.

METALS

HD1	0.74467		31	0.15677		31	0.92104		31	0.88184		31
HD2	-0.79512		33	-1.52770		33	-0.47350		33	-0.82275		32
HD3	0.36629		33	-0.31269		33	0.02680		33	0.09827		33
HD4	1.33115		33	0.93806		33	1.52770		33	1.65277		33
HE1	1.81359		33	0.72365		33	1.63491		33	1.68851		33
HE2	1.88200		30	-0.52449		30	0.73018		30	0.70961		30
HE3	2.23160	*	28	0.66037		28	1.66231		28	1.93557		28
HE4	1.27755		33	0.33338		34	1.05144		34	1.11982		34
HB1	-2.62066	**	35	-2.81721	**	35	-2.99738	**	35	-2.91549	**	35
HB2	-2.66980	**	35	-2.58791	**	35	-2.79528	**	34	-2.81238	**	34
HB3	1.42499		35	-0.09827		35	0.55689		35	0.49137		35
HB4	-2.48963	*	35	-2.80083	**	35	-2.84997	**	35	-2.76808	**	35
H1	-0.37398		32	-3.14142	**	32	-1.75770		32	-1.60811		32
H2	-0.01960		31	-2.87964	**	32	-1.81380		32	-1.83250		32

NON-BANK FINANCE

HD1	2.30287	*	29	1.15684		29	2.38936	*	29	2.54073	*	29
HD2	1.20009		29	-0.46490		29	0.97917		28	1.17846		29
HD3	2.52710	*	26	-0.57145		26	0.74924		26	0.82543		26
HD4	2.19476	*	29	1.30820		29	2.41099	*	29	2.45423	*	29
HE1	1.32138		27	-0.50097		28	0.25049		28	0.29603		28
HE2	0.27326		28	-0.94061		29	0.07568		29	0.11893		29
HE3	2.86928	**	30	1.12098		30	2.43735	*	30	2.45792	*	30
HE4	1.71746		30	0.15426		30	1.82030		30	2.19476	*	29
HB1	0.66847		30	-0.50392		30	0.09256		30	0.11313		30
HB2	2.76644	**	30	-0.17483		30	1.20325		30	1.16211		30
HB3	0.79188		30	-1.59405		30	-0.27029		29	-0.20494		28
HB4	-1.32666		30	-1.37307		29	-0.87574		29	-0.95643		30
H1	2.58133	**	30	-0.17483		30	0.99756		30	1.04873		29
H2	2.39621	*	30	-0.15426		30	0.96223		29	0.93586		30

Positive values indicate superiority of IBES method. An "*" indicates significance at the .05 level, an "**" indicates significance at the .01 level.

				PETROLEUM REFINING				
HD1	1.81748	15	-1.76068	15	0.79515	15	1.19272	15
HD2	1.86152	16	-1.44785	16	1.49956	16	1.44785	16
HD3	1.93107	15	0.20684	16	1.18930	16	2.06835 *	16
HD4	1.19272	15	-1.96493 *	16	-0.56880	16	-0.98247	16
HE1	2.84398 **	16	-0.46538	16	2.63715 **	16	2.53373 *	16
HE2	3.15424 **	16	0.56880	16	1.86152	16	1.96493 *	16
HE3	-0.72193	14	-2.22857 *	14	-1.60080	14	-1.60080	14
HE4	2.22348 *	16	-1.81748	15	1.03418	16	0.72392	16
HB1	-1.65468	16	-2.37860 *	16	-2.01664 *	16	-1.96493 *	16
HB2	-1.60297	16	-1.75810	16	-1.18930	16	-1.18930	16
HB3	2.27519 *	16	-0.82734	16	1.29272	16	1.24101	16
HB4	-1.65468	16	-2.37860 *	16	-2.01664 *	16	-2.06835 *	16
H1	2.10146 *	15	-3.01020 **	15	-1.81748	15	-1.81748	15
H2	1.70389	15	-2.89661 **	15	-1.19272	15	-1.09859	14
				PUBLISHING AND PRINTING				
HD1	1.49956	16	0.17039	15	0.82734	16	0.82734	16
HD2	0.68412	19	-0.12073	19	0.04024	19	0.37018	18
HD3	0.44266	19	-0.44266	19	0.12073	19	0.40242	19
HD4	1.53849	17	0.02178	18	0.76213	18	0.93633	18
HE1	0.96581	19	0.60363	19	0.54438	18	0.64388	19
HE2	1.53064	20	0.82132	20	1.32799	19	1.32799	19
HE3	-1.11245	17	-0.76213	18	-0.67503	18	-0.76213	18
HE4	1.56797	20	0.89598	20	1.02343	18	1.56797	20
HB1	1.15731	20	0.89598	20	1.45597	20	1.54604	18
HB2	2.05330 *	20	1.38131	20	2.05330 *	20	2.29381 *	19
HB3	0.48291	19	0.85865	20	1.00798	20	0.89598	20
HB4	0.68412	19	0.63466	20	1.08654	19	1.32799	19
H1	2.61329 **	20	1.75464	20	2.27729 *	20	2.31463 *	20
H2	2.57595 **	20	1.60531	20	2.27729 *	20	2.31463 *	20

Positive values indicate superiority of IBES method. An "*" indicates significance at the .05 level, an "**" indicates significance at the .01 level.

			REAL ESTATE					
HD1	1.46059	4	0.00000	4	1.09545	4	1.09545	4
HD2	1.95475	9	0.29617	9	1.59934	9	1.59934	9
HD3	0.17770	9	-0.41464	9	-0.29617	9	-0.05923	9
HD4	0.73030	4	0.00000	4	1.09545	4	1.09545	4
HE1	0.88911	11	0.62238	11	0.88911	11	0.97802	11
HE2	2.19169 *	9	2.07322 *	9	2.07322 *	9	2.07322 *	9
HE3	0.42008	8	-0.28006	8	-0.14003	8	0.14003	8
HE4	1.37605	10	1.37605	10	1.27412	10	1.27412	10
HB1	-0.53347	11	-0.80020	11	-0.44455	11	-0.44455	11
HB2	-0.08891	11	-0.26673	11	0.00000	11	0.00000	11
HB3	0.35564	11	-0.08891	11	0.08891	11	0.17782	11
HB4	-0.53347	11	-0.71129	11	-0.35564	11	-0.44455	11
H1	-0.14003	8	-0.28006	8	0.14003	8	0.14003	8
H2	0.44455	11	-0.17782	11	0.44455	11	0.44455	11
			RESTAURANTS AND SPECIALTY TRADE					
HD1	1.60357	3	0.53452	3	0.53452	3	1.60357	3
HD2	0.94346	6	1.99174 *	6	2.20140 *	6	2.20140 *	6
HD3	0.28006	8	0.70014	8	0.56011	8	0.98020	8
HD4	0.40452	5	1.21356	5	1.48324	5	1.75292	5
HE1	-0.25482	10	0.41464	9	0.25482	10	0.66254	10
HE2	-0.77005	9	-1.17219	10	-0.15289	10	0.15289	10
HE3	-0.52414	6	-0.52414	6	-0.10483	6	0.10483	6
HE4	0.53311	9	0.53311	9	1.00699	9	1.48087	9
HB1	0.15289	10	-0.56061	10	-0.25482	10	-0.15289	10
HB2	-0.17770	9	-0.66254	10	-0.41464	9	1.00699	9
HB3	-0.45868	10	-1.07026	10	-0.88852	9	-0.41464	9
HB4	0.00000	8	-0.66254	10	-0.66254	10	-0.25482	10
H1	-0.66254	10	-0.05096	10	-0.86640	10	0.15289	10
H2	0.76447	10	0.17770	9	-0.66254	10	0.25482	10

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			RETAIL TRADE					
HD1	-0.07845	12	-0.47068	12	0.15689	12	-0.07845	12
HD2	0.39223	12	0.31379	12	1.49048	12	0.39223	12
HD3	-0.38437	13	-1.71220	13	-1.36277	13	-1.22300	13
HD4	0.35564	11	-0.35564	11	0.62238	11	0.53347	11
HE1	-0.03494	13	1.85197	13	0.31449	13	0.31379	12
HE2	0.03494	13	0.38437	13	-0.10483	13	-0.03494	13
HE3	-1.09825	12	-1.49048	12	-1.01980	12	-1.25514	12
HE4	1.22300	13	2.48094 *	13	1.57243	13	1.49048	12
HB1	-0.10483	13	-0.66391	13	-0.31449	13	-0.45426	13
HB2	-0.17471	13	-0.38437	13	-0.31449	13	-0.59403	13
HB3	-0.24460	13	-0.24460	13	0.03494	13	0.03494	13
HB4	-0.78446	12	-1.22300	13	-1.01334	13	-1.15311	13
H1	0.10483	13	-0.80369	13	-0.31449	13	-0.38437	13
H2	-0.24460	13	-0.87357	13	-0.59403	13	-0.52414	13
			RUBBER, PLASTIC, AND LEATHER PRODUCTS					
HD1	0.70014	8	0.14003	8	0.42008	8	1.12022	8
HD2	1.17670	12	0.17782	11	-0.23534	12	-0.15689	12
HD3	1.09825	12	-0.07845	12	0.47068	12	0.23534	12
HD4	0.77005	9	0.53311	9	0.29617	9	-0.17770	9
HE1	1.15311	13	-0.03494	13	0.45426	13	0.52414	13
HE2	0.80369	13	-0.24460	13	0.03494	13	0.03494	13
HE3	1.77822	11	1.68931	11	1.86713	11	1.86713	11
HE4	0.66391	13	-0.80369	13	0.45426	13	0.45426	13
HB1	-1.08323	13	-1.57243	13	-1.29289	13	-1.29289	13
HB2	-0.87357	13	-1.43266	13	-1.22300	13	-1.22300	13
HB3	0.52414	13	-1.01334	13	-0.17471	13	0.03494	13
HB4	-0.47068	12	-1.78209	13	-1.36277	13	-0.45426	13
H1	-0.80020	11	-2.03961 *	12	-1.33359	12	-1.25514	12
H2	-1.17670	12	-1.96116 *	12	-0.70602	12	-0.54913	12

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SERVICE

HD1	1.01334	13	0.87357	13	1.78209	13	1.80427	12
HD2	1.53802	14	1.34970	14	1.53802	14	1.78913	14
HD3	2.35412 *	14	1.72635	14	2.22857 *	14	2.35412 *	14
HD4	1.60080	14	0.59638	14	1.91468	14	2.29134 *	14
HE1	1.82252	17	-0.35504	17	1.34914	17	1.49115	17
HE2	2.19929 *	18	0.15243	18	1.58959	18	1.58959	18
HE3	1.97746 *	14	1.47525	14	1.72635	14	1.85191	14
HE4	1.54604	18	0.16568	17	1.28474	18	1.37184	18
HB1	0.10888	18	-0.67503	18	-0.15243	18	0.02178	18
HB2	-0.37018	18	-0.97988	18	-0.58793	18	-0.54438	18
HB3	1.50249	18	0.23953	18	0.89278	18	0.97043	17
HB4	0.15243	18	-0.71858	18	-0.02178	18	0.02178	18
H1	-0.30770	17	-1.63317	17	-0.87576	17	-0.82842	17
H2	0.82842	17	-1.15978	17	-0.26036	17	-0.26036	17

SOCIAL SERVICES

HD1	-1.00000	1	1.00000	1	-1.00000	1	-1.00000	1
HD2	1.48324	5	0.67420	5	1.21356	5	1.21356	5
HD3	1.15311	6	-0.40452	5	1.36277	6	1.15311	6
HD4	-0.53452	3	-0.53452	3	0.00000	3	0.00000	3
HE1	0.67420	5	0.10483	6	-0.52414	6	-0.31449	6
HE2	0.10483	6	0.10483	6	0.10483	6	-0.94346	6
HE3	-0.73380	6	-1.57243	6	0.52414	6	0.52414	6
HE4	0.73380	6	-0.50709	7	0.16903	7	0.16903	7
HB1	0.50709	7	-0.50709	7	0.00000	7	-0.16903	7
HB2	0.00000	7	-0.16903	7	-0.50709	7	-0.33806	7
HB3	2.20140 *	6	0.73380	6	1.15311	6	1.15311	6
HB4	0.67612	7	-0.50709	7	-0.16903	7	0.00000	7
H1	-0.10483	6	-1.15311	6	-0.73380	6	-0.73380	6
H2	0.10483	6	-1.15311	6	-0.73380	6	-0.73380	6

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STONE, CLAY, GLASS AND CONCRETE PRODUCTS

HD1	-0.28006	8	-2.10042 *	8	-0.56011	8	0.00000	8
HD2	0.56011	8	-1.82036	8	0.00000	7	0.70014	8
HD3	0.00000	8	-1.26025	8	0.28006	8	0.84017	8
HD4	-0.28006	8	-2.10042 *	8	0.28006	8	-0.56011	8
HE1	1.12022	8	-1.12022	8	-0.50709	7	0.00000	8
HE2	0.84017	8	-0.14003	8	0.14003	8	0.50709	7
HE3	1.26025	8	-0.14003	8	0.98020	8	0.98020	8
HE4	1.68034	8	-1.54031	8	1.82036	8	0.84017	8
HB1	0.42008	8	-1.26025	8	-0.56011	8	0.00000	8
HB2	-0.42008	8	-1.82036	8	-0.28006	8	0.42008	8
HB3	0.33806	7	-1.26025	8	-0.42008	8	-0.42008	8
HB4	0.98020	8	-1.40028	8	-0.28006	8	0.14003	8
H1	-0.67612	7	-1.18322	7	-0.67612	7	-0.50709	7
H2	-1.01419	7	-1.18322	7	-0.84515	7	-0.67612	7

TEXTILES

HD1	-1.48087	9	-0.65158	9	-1.48087	9	-1.48087	9
HD2	0.53347	11	-0.53347	11	-0.26673	11	-0.26673	11
HD3	1.86713	11	-0.26673	11	0.76447	10	0.97802	11
HD4	-0.26673	11	-0.80020	11	-0.35564	11	-0.35564	11
HE1	0.88911	11	-0.35564	11	-0.80020	11	-0.17782	11
HE2	2.27495 *	12	-0.07845	12	1.25514	12	1.33359	12
HE3	1.54031	8	1.54031	8	1.82036	8	1.82036	8
HE4	0.53347	11	-1.06693	11	-0.26673	11	0.08891	11
HB1	-0.23534	12	0.47068	12	0.62757	12	0.00000	12
HB2	-0.47068	12	0.23534	12	0.47068	12	-0.31379	12
HB3	-1.09825	12	-1.56893	12	-1.25514	12	-0.94136	12
HB4	-0.07845	12	0.62757	12	-0.31379	12	0.07845	12
H1	-1.33366	11	-1.06693	11	-0.88911	11	-0.71129	11
H2	-0.54913	12	-0.62757	12	-1.33359	12	-1.17670	12

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				TRANSPORTATION				
HD1	0.56011	8	-0.98020	8	0.42008	8	0.84017	8
HD2	-0.35564	11	-0.35564	11	-0.71129	11	-0.53347	11
HD3	1.41247	14	-0.11359	15	0.96554	15	0.90874	15
HD4	-0.35675	10	-0.25482	10	0.35675	10	0.35675	10
HE1	0.00000	16	-0.82734	16	-0.41367	16	-0.05171	16
HE2	0.77563	16	-0.25854	16	-0.67221	16	-0.51709	16
HE3	0.59403	13	-0.52414	13	0.24460	13	0.38437	13
HE4	-0.62476	15	-1.07913	15	-0.90874	15	-0.68155	15
HB1	0.12073	19	-1.40848	19	-0.37018	18	-0.24145	19
HB2	-0.58793	18	-1.56945	19	-0.71858	18	-0.76213	18
HB3	-0.05171	16	-1.65468	16	-0.34078	15	-0.31025	16
HB4	-1.00606	19	-2.13284 *	19	-1.15409	18	-0.92557	19
H1	-0.73835	15	-2.44224 *	15	-1.47670	15	-1.19272	15
H2	0.35504	17	-2.39058 *	17	-1.44381	17	-1.11245	17
				TRANSPORTATION EQUIPMENT				
HD1	1.62857	24	0.01345	25	1.68168	25	2.11219 *	25
HD2	1.20000	24	-0.22871	25	0.60541	25	0.84757	25
HD3	0.77464	26	-0.74924	26	0.24128	26	0.41907	26
HD4	1.85714	24	0.31429	24	2.02857 *	24	2.37143 *	24
HE1	2.80089 **	28	0.72869	28	1.79894	28	1.86726	28
HE2	2.62722 **	29	1.28658	29	2.12989 *	29	2.17313 *	29
HE3	2.12650 *	22	0.79541	22	1.67198	22	1.67198	22
HE4	2.95908 **	31	0.43112	31	1.99885 *	31	2.25360 *	31
HB1	1.80288	31	-0.60749	31	0.68588	31	1.58732	31
HB2	2.25360 *	31	-0.13718	31	0.76427	31	1.54813	31
HB3	2.99269 **	30	0.54506	30	1.82030	30	2.47849 *	30
HB4	1.95966	31	-0.84265	31	0.79188	30	1.61462	30
H1	0.40000	24	-0.60000	24	-0.05714	24	0.11429	24
H2	1.80188	27	-0.28830	27	1.33339	26	1.41748	27

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UTILITIES

HD1	-2.22572 *	127	3.18217 **	125	2.09512 *	126	1.76399	126
HD2	-2.86925 **	131	2.48054 *	130	0.72518	129	0.32183	130
HD3	-4.75776 **	130	-0.51368	128	-1.98278 *	129	-2.48517 *	128
HD4	-2.75628 **	128	2.68270 **	130	1.06821	131	0.56582	130
HE1	3.64994 **	132	4.71744 **	132	5.00839 **	128	5.08540 **	130
HE2	1.83939	129	2.84627 **	131	2.49052 *	129	2.49287 *	129
HE3	4.94711 **	127	5.20189 **	126	5.31876 **	126	5.24307 **	127
HE4	2.57985 **	129	4.32799 **	131	4.26292 **	129	4.17637 **	131
HB1	4.74379 **	131	4.81738 **	132	5.28753 **	132	5.28291 **	130
HB2	5.42608 **	132	4.56981 **	132	5.15580 **	132	5.12955 **	130
HB3	6.12464 **	129	5.60525 **	131	6.16126 **	130	6.20077 **	130
HB4	3.19856 **	130	4.42672 **	132	4.67428 **	129	4.73728 **	128
H1	2.06993 *	112	3.28946 **	111	3.34150 **	112	3.33313 **	109
H2	2.07474 *	124	3.52958 **	125	3.35957 **	125	3.21934 **	124

WHOLESALE TRADE

HD1	1.16137	14	-1.13592	15	0.17039	15	0.09416	14
HD2	0.05171	16	-1.44785	16	-0.10342	16	-0.72392	16
HD3	-0.07101	17	-2.06864 *	18	-1.45894	18	-1.63314	18
HD4	2.20122 *	17	-0.68640	17	1.30180	17	1.15978	17
HE1	2.34324 *	17	-0.80568	18	0.80568	18	0.54438	18
HE2	0.11835	17	-1.15978	17	-1.01777	17	-1.11245	17
HE3	1.01777	17	-0.23953	18	0.41373	18	0.15243	18
HE4	0.89278	18	-1.11053	18	-0.10888	18	-0.45728	18
HB1	-0.07467	20	-1.82930	20	-1.23198	20	-1.38131	20
HB2	0.52266	20	-1.08265	20	-0.18666	20	-0.55999	20
HB3	1.48896	19	0.33599	20	0.85865	20	0.63466	20
HB4	-0.33599	20	-2.09063 *	20	-1.00798	20	-1.26931	20
H1	-1.04630	19	-2.17308 *	19	-1.60969	19	-1.93163	19
H2	-1.23198	20	-2.23996 *	20	-2.01596 *	20	-2.12796 *	20

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APPENDIX 9

ACCURACY OF FORECASTS BY HISTORICAL METHODS VERSUS IBES FORECASTS.
WILCOXON SIGNED RANKS: ERRORS ASSESSED AGAINST ACTUAL EARNINGS GROWTH

				AGRICULTURE AND MINING								
HD1	1.75727		53	-1.22611		53	0.34083		53	0.40280		53
HD2	2.76096	**	57	-0.75488		58	0.99489		58	0.99489		58
HD3	1.70922		55	-1.15624		55	0.67028		55	0.72893		55
HD4	2.86635	**	35	-0.40948		35	1.89998		35	1.37585		35
HE1	3.57309	**	58	-0.24154		59	2.19646	*	59	2.39271	*	59
HE2	1.77774		61	-0.69199		60	0.62849		61	0.69314		61
HE3	2.27335	*	50	-0.22496		51	1.52788		51	1.65910		51
HE4	2.87268	**	45	-0.84092		45	0.61517		45	0.66032		45
HB1	-1.79186		66	-3.49748	**	66	-3.04392	**	66	-3.03753	**	66
HB2	-0.16664		65	-2.46261	*	66	-0.99973		66	-0.98057		66
HB3	2.43669	*	60	0.13251		60	1.31773		60	1.40607		60
HB4	-2.26402	*	44	-3.82084	**	45	-3.62895	**	45	-3.61766	**	45
H1	0.08978		61	-3.55188	**	61	-2.87670	**	61	-2.68277	**	61
H2	0.47238		63	-3.67636	**	63	-2.24004	*	62	-2.09982	*	62
				BANKING								
HD1	0.50088		52	-2.16745	*	52	-0.84544		53	-0.78347		53
HD2	1.70416		53	-1.95203		53	-0.19684		51	0.20622		51
HD3	2.34337	*	51	-1.07561		53	0.45592		53	0.64183		53
HD4	0.20804		53	-1.93433		53	-1.12015		52	-0.99594		53
HE1	0.47356		52	-2.26879	*	54	-1.23496		53	-1.23854		52
HE2	1.48443		52	-0.75587		52	0.88337		52	1.15658		52
HE3	3.12136	**	51	0.96547		51	2.29650	*	51	2.39961	*	51
HE4	1.60678		53	-3.18148	**	54	-1.04905		53	-1.02908		52
HB1	0.99448		54	-1.22696		54	0.08180		54	0.15068		54
HB2	1.11502		54	-0.67590		54	0.61563		54	0.65007		54
HB3	-0.57178		51	-1.27001		54	-0.33198		53	-0.38510		53
HB4	0.49177		52	-1.14643		53	0.05597		54	0.21956		54
H1	0.93421		54	-1.37333		54	0.00431		54	-0.34871		54
H2	1.57998		54	-1.34750		54	-0.32288		54	-0.10763		54

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CHEMICALS AND DRUGS

HD1	1.82083		61	-2.47447	*	61	-0.80978		62	-0.38428		61
HD2	-0.48032		65	-3.58691	**	66	-2.64338	**	65	-2.43067	*	66
HD3	0.86946		63	-3.15964	**	65	-0.88275		64	-0.93776		65
HD4	2.47347	*	65	-2.08791	*	65	-0.00685		63	0.33438		64
HE1	0.29425		64	-4.35357	**	64	-2.37545	*	65	-2.40159	*	65
HE2	-0.72894		64	-4.04839	**	65	-2.44080	*	65	-2.34931	*	65
HE3	3.35077	**	61	-0.74342		61	2.23744	*	61	2.12014	*	60
HE4	0.65538		64	-4.14906	**	66	-1.23837		65	-1.13389		66
HB1	-1.00311		65	-4.38542	**	66	-2.77562	**	66	-2.43705	*	66
HB2	-0.76786		65	-3.77855	**	66	-2.58398	**	66	-2.39505	*	65
HB3	-0.44138		64	-3.36382	**	64	-1.91006		63	-1.69863		64
HB4	-1.19263		65	-4.67288	**	66	-3.03115	**	66	-2.83312	**	66
H1	-0.44764		65	-4.31633	**	65	-2.54536	*	65	-2.39413	*	64
H2	-0.45475		64	-4.29338	**	64	-2.98320	**	65	-2.88232	**	64

CONSUMER GOODS

HD1	0.00000		20	-3.21061	**	20	-1.56797		20	-2.09063	*	20
HD2	0.55159		25	-2.78108	**	26	-2.52710	*	26	-1.96834	*	26
HD3	-0.37143		24	-3.14286	**	24	-2.05838	*	25	-1.76240		25
HD4	1.19914		21	-2.31139	*	21	-0.95584		21	-0.46923		21
HE1	0.14286		24	-3.34286	**	24	-1.68571		24	-1.54286		24
HE2	0.05714		24	-2.54286	*	24	-1.80000		24	-1.51429		24
HE3	0.67503		18	-0.36218		19	-0.20121		19	0.12073		19
HE4	1.84312		25	-3.59207	**	25	-1.52024		25	-1.00000		24
HB1	-2.55250	*	26	-3.69541	**	26	-3.31444	**	26	-3.06046	**	26
HB2	-1.68897		26	-3.41603	**	26	-2.95887	**	26	-2.42551	*	26
HB3	-0.84757		25	-1.96834	*	26	-1.51118		26	-1.49333		25
HB4	-2.22232	*	26	-3.33984	**	26	-2.88267	**	26	-2.67949	**	26
H1	-2.51609	*	22	-3.65239	**	22	-3.36020	**	22	-2.93814	**	22
H2	-2.73735	**	23	-3.83229	**	23	-3.55855	**	23	-3.22399	**	23

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				ELECTRONICS				
HD1	0.81835	45	-3.95773 **	47	-2.28887 *	46	-1.97886 *	47
HD2	2.07223 *	61	-3.91637 **	60	-1.00200	61	-1.03791	61
HD3	0.67776	63	-2.64944 **	63	-1.33499	63	-1.22545	63
HD4	1.99655 *	51	-3.31590 **	50	-0.70301	51	-0.18824	50
HE1	0.10166	62	-4.45554 **	62	-2.19075 *	63	-2.25237 *	63
HE2	-0.17800	63	-4.39475 **	65	-2.70220 **	65	-2.54536 *	65
HE3	3.35962 **	53	-0.94282	54	1.73496	54	1.96744 *	54
HE4	1.60433	65	-3.80643 **	63	-0.65676	65	-0.72865	65
HB1	-0.82153	63	-4.42044 **	64	-2.55463 *	64	-2.36738 *	64
HB2	-0.35444	64	-2.46100 *	64	-1.92600	64	-1.77888	64
HB3	0.67544	64	-2.10657 *	64	-0.66875	64	-0.54336	62
HB4	-0.84263	64	-4.32286 **	65	-2.60417 **	65	-2.48001 *	65
H1	-1.25296	59	-4.59672 **	59	-2.95881 **	59	-2.83049 **	59
H2	-0.54084	63	-4.23089 **	63	-2.52621 *	63	-2.44336 *	62
				FOOD AND BEVERAGE				
HD1	0.19578	38	-2.37112 *	38	-0.89189	38	-0.87739	38
HD2	0.33944	37	-1.68103	36	-0.86746	37	-0.83729	37
HD3	1.90705	38	-1.74753	38	0.63085	38	0.67134	37
HD4	0.27910	37	-2.69290 **	37	-0.73840	36	-0.39979	37
HE1	0.06552	35	-1.86316	37	-0.70151	37	-0.41487	37
HE2	0.20366	37	-2.24819 *	34	-1.24462	37	-1.07867	37
HE3	2.51369 *	36	0.29850	36	1.44537	36	1.53014	34
HE4	0.38470	37	-2.19710 *	38	0.63879	35	0.87979	36
HB1	0.05076	38	-1.68952	38	-0.65985	38	-0.58734	38
HB2	-0.19578	38	-1.29795	38	-0.99341	38	-0.93540	38
HB3	0.80258	35	-0.91121	36	0.08297	37	0.26401	37
HB4	0.12327	38	-1.37047	38	-0.41332	38	-0.26829	38
H1	-0.17282	36	-1.63390	36	-1.25685	36	-1.20971	36
H2	0.29850	36	-1.45583	37	-0.70151	37	-0.62608	37

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FOREST PRODUCTS

HD1	1.68571		24	-2.97321	**	25	-1.25117		25	-0.82066		25
HD2	1.54715		25	-3.21285	**	26	-1.71436		26	-2.06994	*	26
HD3	-0.01345		25	-3.26919	**	25	-3.05393	**	25	-2.94631	**	25
HD4	2.37471	*	26	-3.03506	**	26	-0.39367		26	-0.39367		26
HE1	1.60968		27	-3.02715	**	27	-0.79283		27	-0.49526		26
HE2	1.52024		25	-3.17130	**	27	-1.48955		27	-1.77785		27
HE3	2.22029	*	23	-1.73365		23	-0.24332		23	0.18249		23
HE4	1.63817		26	-3.82240	**	26	-1.79056		26	-1.48578		26
HB1	0.00000		27	-3.94010	**	27	-2.69080	**	27	-2.49860	*	27
HB2	0.55258		27	-2.90703	**	27	-1.65773		27	-1.34540		27
HB3	-0.57660		27	-2.69080	**	27	-2.47458	*	27	-2.25835	*	27
HB4	0.33635		27	-3.81998	**	27	-2.45055	*	27	-2.21030	*	27
H1	-0.27373		23	-3.91496	**	25	-2.91940	**	25	-2.91940	**	25
H2	-1.52024		25	-3.94186	**	25	-3.00012	**	25	-3.02703	**	25

MACHINERY

HD1	-0.93499		39	-3.87949	**	39	-4.03300	**	39	-4.20046	**	39
HD2	1.05539		45	-2.94041	**	45	-1.43916		45	-1.42788		45
HD3	0.90865		45	-1.82294		45	-0.66032		45	-0.51349		44
HD4	1.18335		43	-2.62027	**	43	-2.10104	*	43	-2.02859	*	43
HE1	1.81928		42	-2.08186	*	42	-0.68145		42	-0.43411		41
HE2	0.96600		43	-2.06482	*	43	-0.90562		43	-0.89355		43
HE3	0.48991		31	-0.58790		31	-0.76427		31	-0.54870		31
HE4	2.79143	**	46	-1.87938		45	-0.13657		46	0.25675		46
HB1	-2.95242	**	47	-4.68790	**	47	-4.07413	**	47	-4.05878	**	46
HB2	-1.98945	*	47	-3.88365	**	47	-3.35455	**	47	-3.24872	**	47
HB3	0.85764		46	-1.79722		46	-0.67191		46	-0.39878		46
HB4	-3.07941	**	47	-4.65615	**	47	-3.98947	**	47	-3.96831	**	47
H1	-2.46947	*	42	-5.08274	**	42	-4.62011	**	42	-4.54508	**	42
H2	-2.64913	**	44	-5.14656	**	44	-4.59806	**	44	-4.45801	**	44

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				METALS				
HD1	1.11674	33	-2.40322 *	33	-0.83085	33	-0.79512	33
HD2	0.19655	35	-3.66893 **	35	-2.24394 *	35	-2.24394 *	35
HD3	-1.15402	34	-3.39366 **	34	-2.06013 *	34	-2.06013 *	34
HD4	1.93274	35	-1.49050	35	0.21293	35	0.16379	35
HE1	0.26500	34	-2.88076 **	34	-1.01724	34	-0.94886	34
HE2	0.54506	30	-2.64553 **	31	-1.80288	31	-1.62651	31
HE3	1.46553	27	-0.16818	27	0.45648	27	0.45648	27
HE4	0.18017	35	-2.73532 **	35	-1.24482	35	-1.16292	35
HB1	-2.21400 *	34	-4.40235 **	34	-3.66720 **	34	-3.56463 **	33
HB2	-1.67067	35	-3.79996 **	35	-2.66980 **	35	-2.57153 *	35
HB3	-0.67155	35	-2.30946 *	35	-1.78533	35	-1.83447	35
HB4	-1.42756	34	-4.17668 **	35	-3.22669 **	35	-3.17756 **	35
H1	-0.92104	31	-4.42882 **	31	-2.99269 **	30	-2.70432 **	31
H2	-0.90144	31	-4.38963 **	31	-3.70375 **	31	-3.62536 **	31
				NON-BANK FINANCE				
HD1	4.14392 **	35	0.99913	35	2.62432 **	34	3.13721 **	34
HD2	4.18010 **	34	1.06853	34	2.81238 **	34	3.29108 **	34
HD3	2.86779 **	33	-1.75998	33	-0.74796	32	-0.67316	32
HD4	4.54036 **	36	1.73530	34	3.20496 **	36	3.72341 **	36
HE1	0.02680	33	-2.80484 **	32	-1.01902	31	-1.07781	31
HE2	0.24867	29	-2.54306 *	32	-1.10324	32	-1.14064	32
HE3	3.22514 **	33	1.15248	33	2.59915 **	32	2.43086 *	32
HE4	3.44062 **	36	0.14140	36	1.68705	35	1.68401	34
HB1	2.26232 *	36	-1.16258	36	-0.47132	36	-0.37705	36
HB2	0.49137	35	-1.63792	35	-1.63390	36	-0.98977	36
HB3	0.65517	35	-2.40774 *	35	-1.56433	34	-0.99104	32
HB4	0.27695	33	-2.46656 *	36	-1.17829	36	-1.68103	36
H1	1.35216	31	-2.07558 *	32	-0.18699	32	-0.37233	31
H2	0.99942	31	-2.18778 *	32	-0.70548	31	-0.78536	32

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				PETROLEUM REFINING								
HD1	2.20711	*	21	-2.27663	*	21	-0.08689		21	0.05214		21
HD2	1.25714		24	-2.11429	*	24	-0.85714		24	-1.00000		24
HD3	1.45992		23	-2.14286	*	24	0.28571		24	0.25714		24
HD4	1.99664	*	22	-2.41869	*	22	-0.08116		22	-0.21103		22
HE1	2.98067	**	23	-1.27743		23	1.70324		23	1.49033		23
HE2	1.41226		22	-1.28239		22	0.30842		22	0.30842		22
HE3	2.01211	*	19	-0.72436		19	1.12678		19	1.12678		19
HE4	2.97321	**	25	-2.27363	*	25	0.82066		25	0.71303		25
HB1	0.49778		25	-2.70415	**	25	-1.03592		25	-1.06282		25
HB2	0.22871		25	-1.97766	*	25	-0.84757		25	-0.91429		24
HB3	0.94286		24	-2.00000	*	24	-0.62857		24	-0.39539		23
HB4	-0.60000		24	-2.48889	*	25	-1.00901		25	-1.08973		25
H1	0.48532		20	-2.62420	**	21	-2.34614	*	21	-2.45042	*	21
H2	0.37333		20	-3.13294	**	22	-1.24993		22	-1.16438		21
				PUBLISHING AND PRINTING								
HD1	0.60363		19	-0.64388		19	0.60363		19	0.68412		19
HD2	0.63308		22	-1.72050		21	-0.53568		22	-0.22592		21
HD3	0.15641		21	-0.99059		21	0.33599		20	0.39971		21
HD4	0.71253		21	-0.26068		21	0.50399		21	0.46923		21
HE1	-0.14610		22	-1.89429		21	-0.24349		22	-0.08116		22
HE2	0.85156		21	-0.50322		22	0.14610		22	0.22592		21
HE3	1.02535		21	-1.45597		20	-0.29866		20	-0.15641		21
HE4	0.01738		21	-1.50965		22	-0.24145		19	-1.04630		19
HB1	1.57458		22	0.86034		22	0.82787		22	0.92527		22
HB2	1.86678		22	0.40582		22	1.31486		22	1.24993		22
HB3	2.45042	*	21	1.54212		22	2.20711	*	21	2.28883	*	22
HB4	0.92527		22	0.21103		22	0.24349		22	0.30842		22
H1	1.99857	*	21	0.88632		21	2.13760	*	21	1.40769		21
H2	2.22390	*	22	0.99059		21	2.15897	*	22	1.47719		22

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					REAL ESTATE							
HD1	0.14003		8	-0.42008		8	-0.28006		8	-0.14003		8
HD2	2.41106	*	13	1.01334		13	2.06163	*	13	2.06163	*	13
HD3	2.06163	*	13	-0.03494		13	1.50254		13	1.57243		13
HD4	-0.28006		8	-0.28006		8	-0.28006		8	-0.28006		8
HE1	0.38437		13	-1.09825		12	0.23534		12	0.31379		12
HE2	0.94136		12	-0.47068		12	0.54913		12	0.62757		12
HE3	1.68931		11	1.24475		11	1.60040		11	1.60040		11
HE4	1.91468		14	0.72193		14	1.60080		14	1.66358		14
HB1	0.78471		14	-0.72193		14	0.53360		14	0.53360		14
HB2	1.09859		14	-0.09416		14	0.72193		14	0.72193		14
HB3	-0.15694		14	-1.28692		14	-0.34527		14	-0.28249		14
HB4	0.91026		14	0.09416		14	0.53360		14	0.53360		14
H1	0.26673		11	-0.97802		11	0.08891		11	0.08891		11
H2	0.21972		14	-0.28249		14	0.03139		14	0.09416		14
					RESTAURANTS AND SPECIALTY TRADE							
HD1	1.35225		7	1.52128		7	2.02837	*	7	2.02837	*	7
HD2	1.25514		12	1.09825		12	1.33359		12	1.41204		12
HD3	0.91026		14	1.09859		14	1.22414		14	1.22414		14
HD4	1.27412		10	1.47798		10	1.88570		10	1.47798		10
HE1	0.38437		13	0.80369		13	1.16137		14	1.01334		13
HE2	0.47068		12	1.29289		13	1.22300		13	1.08323		13
HE3	0.08891		11	1.33366		11	0.45868		10	0.56061		10
HE4	-0.28249		14	-0.31449		13	-0.28249		14	-0.38437		13
HB1	2.54245	*	14	1.85191		14	2.16579	*	14	2.16579	*	14
HB2	1.66358		14	0.91026		14	1.29289		13	0.94346		13
HB3	0.21972		14	1.03581		14	0.59638		14	0.65915		14
HB4	2.79355	**	14	0.78471		14	2.29134	*	14	2.35412	*	14
H1	2.47967	*	14	1.16137		14	1.34970		14	1.34970		14
H2	2.13151	*	13	0.80369		13	0.94346		13	0.91026		14

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				RETAIL TRADE				
HD1	2.87964 **	32	-0.36629	33	1.64551	32	1.72030	32
HD2	0.63576	32	-2.26032 *	35	-0.69241	34	-0.82918	34
HD3	1.28988	37	-1.05261	36	0.21995	36	0.37705	36
HD4	2.84872 **	30	0.39193	31	2.07558 *	32	1.98209 *	32
HE1	0.40948	35	-1.82243	36	-0.83534	35	-0.83266	36
HE2	0.00000	35	-1.49251	36	-0.26207	35	-0.90085	35
HE3	1.86167	31	0.68791	33	1.34902	33	1.38476	33
HE4	1.86354	38	-1.22953	37	0.34080	38	0.40847	36
HB1	0.71786	38	-2.00952 *	39	-0.96440	38	-1.00476	39
HB2	1.16743	38	-1.08849	39	0.08373	39	0.06978	39
HB3	0.16746	39	-0.58611	39	-0.57216	39	-0.50238	39
HB4	0.65984	36	-2.03743 *	39	-0.85126	39	-0.83388	38
H1	0.68792	35	-1.99524 *	36	-0.86408	36	-0.73840	36
H2	0.68792	35	-2.12093 *	36	-0.76982	36	-0.73840	36
				RUBBER, PLASTIC, AND LEATHER PRODUCTS				
HD1	0.73380	13	-1.60080	14	-1.16137	14	-0.34527	14
HD2	-0.76213	18	-2.02509 *	18	-1.28474	18	-0.93633	18
HD3	-1.41991	15	-2.04466 *	15	-2.21505 *	15	-2.04466 *	15
HD4	1.65468	16	-0.87905	16	-0.05171	16	0.62476	15
HE1	0.00000	19	-1.20727	19	-0.76213	18	-0.40242	19
HE2	0.87576	17	-1.36824	19	-0.24145	19	-0.12073	19
HE3	2.16579 *	14	1.66358	14	2.04024 *	14	2.10301 *	14
HE4	-0.02178	18	-0.84509	19	-1.28775	19	-1.16702	19
HB1	-0.96581	19	-2.25356 *	19	-2.09259 *	19	-1.93163	19
HB2	-0.20121	19	-1.52920	19	0.00000	19	0.24145	19
HB3	-1.02343	18	-1.58959	18	-1.89444	18	-1.89444	18
HB4	-1.24751	19	-2.13284 *	19	-2.37429 *	19	-2.21332 *	19
H1	-2.10301 *	14	-2.78301 **	15	-2.15826 *	15	-1.87427	15
H2	-1.37184	18	-2.67835 **	18	-1.76379	18	-1.50249	18

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				SERVICES				
HD1	2.10284 *	21	0.64302	21	0.95584	21	1.30341	21
HD2	1.80000	24	-1.00000	24	1.00369	23	1.15577	23
HD3	1.65714	24	-0.05714	24	0.60000	24	0.85714	24
HD4	2.91984 **	23	1.34286	24	2.51429 *	24	2.62857 **	24
HE1	-0.30943	25	-2.40817 *	25	-1.17045	25	-0.87447	25
HE2	0.22871	25	-2.19291 *	25	-1.17143	24	-0.92829	25
HE3	1.99664 *	22	0.01623	22	1.58147	21	1.73691	22
HE4	1.25117	25	-1.87003	25	-0.49778	25	-0.01345	25
HB1	-0.65922	25	-2.51580 *	25	-1.89694	25	-1.65478	25
HB2	-0.65922	25	-2.11219 *	25	-1.41261	25	-1.25117	25
HB3	0.84757	25	-1.57405	25	-0.87447	25	-0.52468	25
HB4	-0.33634	25	-2.51580 *	25	-1.52024	25	-1.41261	25
H1	-1.20000	24	-2.34286 *	24	-1.88571	24	-2.42857 *	24
H2	-0.42857	24	-2.45714 *	24	-2.60000 **	24	-1.94286	24
				SOCIAL SERVICES				
HD1	-0.53452	3	0.00000	3	0.00000	3	0.00000	3
HD2	1.24393	9	0.29617	9	1.59934	9	0.65158	9
HD3	0.88852	9	-1.12022	8	1.00699	9	1.00699	9
HD4	1.21356	5	0.40452	5	1.75292	5	0.40452	5
HE1	0.28006	8	-0.70014	8	-1.00699	9	-1.00699	9
HE2	1.71781	9	-1.24393	9	0.65158	9	0.41464	9
HE3	0.14003	8	-0.28006	8	0.56011	8	0.70014	8
HE4	-0.05923	9	-1.37605	10	-0.05096	10	-0.35675	10
HB1	0.96833	10	-0.35675	10	0.15289	10	0.05096	10
HB2	0.96833	10	0.76447	10	0.45868	10	0.35675	10
HB3	1.12546	9	0.41464	9	1.00699	9	1.00699	9
HB4	-0.15289	10	-0.45868	10	0.45868	10	0.15289	10
H1	-0.77005	9	-1.48087	9	-0.53311	9	-0.53311	9
H2	0.65158	9	-1.83628	9	-0.41464	9	-0.29617	9

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			STONE, CLAY, GLASS, AND CONCRETE PRODUCTS									
HD1	-0.70014		8	-2.52050	*	8	-2.38048	*	8	-2.38048	*	8
HD2	1.17219		10	-2.80306	**	10	-2.59920	**	10	-1.17219		10
HD3	0.56061		10	-2.49727	*	10	-1.68184		10	-1.47798		10
HD4	-0.41464		9	-1.59934		9	-2.19169	*	9	-2.54710	*	9
HE1	-0.05096		10	-1.78377		10	-2.39534	*	10	-2.29341	*	10
HE2	1.07026		10	-1.17219		10	-1.07026		10	-0.35675		10
HE3	0.66254		10	-1.17219		10	-0.96833		10	-0.76447		10
HE4	0.76447		10	-1.78377		10	-1.37605		10	-1.07026		10
HB1	-2.29341	*	10	-2.29341	*	10	-1.88570		10	-2.80306	**	10
HB2	-0.66254		10	-2.49727	*	10	-2.19148	*	10	-1.68184		10
HB3	-1.71781		9	-2.29341	*	10	-1.47798		10	-2.49727	*	10
HB4	-1.27412		10	-1.88570		10	-2.80306	**	10	-2.80306	**	10
H1	-1.71781		9	-2.80306	**	10	-2.70113	**	10	-2.80306	**	10
H2	-1.59934		9	-2.80306	**	10	-2.49727	*	10	-2.59920	**	10
						TEXTILES						
HD1	0.56796		15	-1.19272		15	-1.13592		15	-0.96554		15
HD2	-1.15978		17	-1.72784		17	-1.49115		17	-1.34914		17
HD3	1.01777		17	-0.21302		17	0.79515		15	1.18930		16
HD4	0.35504		17	-0.26036		17	-0.11835		17	0.16568		17
HE1	0.41367		16	0.36196		16	0.77563		16	1.13759		16
HE2	-0.34078		15	-1.76068		15	-0.59638		14	-0.56796		15
HE3	2.55083	*	13	2.41106	*	13	2.55083	*	13	2.62071	**	13
HE4	1.82252		17	0.59173		17	1.11245		17	1.49956		16
HB1	0.10342		16	-0.82842		17	-0.10342		16	0.25854		16
HB2	0.35504		17	-0.78108		17	0.26036		17	0.54439		17
HB3	0.26036		17	0.21302		17	0.35504		17	0.49705		17
HB4	0.00000		16	-0.92309		17	0.10342		16	0.31025		16
H1	0.53360		14	-0.45437		15	0.17039		15	0.11359		15
H2	0.77563		16	-0.46538		16	0.25854		16	0.31025		16

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			TRANSPORTATION EQUIPMENT					
HD1	0.10342	16	-2.17177 *	16	-1.86152	16	-1.29272	16
HD2	-0.92557	19	-2.69623 **	19	-2.50415 *	18	-2.01211 *	19
HD3	1.44472	22	-1.06452	23	-0.06083	23	0.04870	22
HD4	0.06533	18	-2.54770 *	18	-1.58959	18	-0.84923	18
HE1	0.07467	20	-2.64595 **	22	-1.96381 *	21	-1.37979	22
HE2	-0.27596	22	-3.23033 **	22	-2.54855 *	22	-2.22390 *	22
HE3	-0.44799	20	-1.04532	20	-0.67199	20	-0.63466	20
HE4	0.74729	21	-1.75464	20	-0.46923	21	-0.29544	21
HB1	-0.30415	23	-2.76776 **	23	-1.97697 *	23	-1.70324	23
HB2	-1.42950	23	-2.25071 *	23	-2.46361 *	23	-2.49403 *	23
HB3	1.26866	21	-1.99664 *	22	-0.69801	22	-0.50322	22
HB4	-0.51705	23	-2.91984 **	23	-2.03780 *	23	-1.82490	23
H1	-0.78399	20	-2.86751 **	21	-2.10284 *	21	-1.69017	19
H2	-0.99020	22	-3.03554 **	22	-2.31139 *	21	-1.93171	22
			TRANSPORTATION					
HD1	0.08571	24	-1.33189	25	-0.47087	25	-0.17489	25
HD2	-0.22857	24	-1.68168	25	-1.49333	25	-0.95520	25
HD3	-0.07208	27	-2.97910 **	27	-1.20125	27	-1.10515	27
HD4	2.03147 *	25	-0.98210	25	1.27808	25	1.35880	25
HE1	0.69844	26	-1.40959	26	0.21588	26	0.46986	26
HE2	1.20125	27	-0.09610	27	0.76880	27	0.74478	27
HE3	1.06011	21	-0.71253	21	0.39971	21	0.43447	21
HE4	2.14051 *	28	-0.93363	28	0.88809	28	1.68509	28
HB1	0.50097	28	-3.21077 **	28	-1.52569	28	-0.81977	28
HB2	-0.27326	28	-2.32269 *	28	-1.02471	28	-0.86531	28
HB3	0.66037	28	-1.93557	28	-0.54651	28	0.15940	28
HB4	0.00000	28	-3.23354 **	28	-1.63954	28	-0.84254	28
H1	-0.66555	22	-2.25636 *	22	-1.73691	22	-1.63952	22
H2	-0.68613	25	-2.48889 *	25	-1.89694	25	-1.84312	25

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				UTILITIES				
HD1	-1.49014	120	-4.07924	**130	-1.41243	127	-1.58761	123
HD2	-1.39212	131	-3.78417	**135	-1.27993	129	-1.04933	132
HD3	0.11295	136	-4.04671	**130	0.02953	132	0.18473	130
HD4	-0.75554	127	-3.97246	**132	-0.94347	126	-1.07008	126
HE1	2.03535	* 131	-2.81561	**135	0.54738	132	0.89034	132
HE2	2.95961	**127	-1.06296	132	1.73753	132	2.03594	* 135
HE3	9.03102	**130	7.45660	**132	8.60929	**133	8.66094	**133
HE4	0.89046	133	-3.57974	**136	0.05534	127	0.02854	128
HB1	3.32404	**130	-0.28253	137	2.51741	* 138	2.97033	**137
HB2	3.83823	**136	0.03082	138	2.70800	**139	2.81070	**138
HB3	4.09823	**135	0.00217	136	2.78690	**136	2.98692	**135
HB4	3.14076	**133	-0.10205	137	2.65748	**135	2.73714	**134
H1	1.43166	115	-1.69120	115	0.10320	114	0.55786	108
H2	2.10965	* 124	-2.66973	**126	0.21166	128	0.71178	123
				WHOLESALE TRADE				
HD1	0.63148	18	-2.09259	* 19	-0.52315	19	-0.49705	17
HD2	0.45714	24	-1.28571	24	0.03042	23	0.08571	24
HD3	1.30784	23	-0.85714	24	0.20000	24	0.14286	24
HD4	2.32129	* 22	-0.73048	22	0.73048	22	0.76294	22
HE1	1.30341	21	-1.64241	23	-0.06083	23	-0.04870	22
HE2	0.60000	24	-1.33826	23	-0.54286	24	-0.51429	24
HE3	2.22390	* 22	0.01623	22	1.24993	22	1.21746	22
HE4	1.08571	24	-2.40000	* 24	-0.94286	24	-0.76685	25
HB1	0.36324	25	-2.05838	* 25	-1.19736	25	-1.19736	25
HB2	0.57850	25	-0.92829	25	-0.65922	25	-0.73994	25
HB3	1.02857	24	-0.14286	24	0.20000	24	0.20000	24
HB4	0.85714	24	-2.11219	* 25	-0.82066	25	-0.84757	25
H1	-0.44396	25	-2.56961	* 25	-1.60096	25	-1.73550	25
H2	-0.34286	24	-2.46198	* 25	-1.57405	25	-1.68168	25

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BIOGRAPHICAL SKETCH

Steve R. Vinson is a Vice President with Citibank, N.A., New York City. He is responsible for the analysis of corporate finance and investment banking issues for client firms within the regulated utility industry. Prior to joining Citibank, Mr. Vinson served as Senior Financial and Regulatory Economist for the American Telephone & Telegraph Company where he provided expert financial and economic testimony before federal and state regulatory authorities. During the period 1980 to 1983, while at the University of Florida, Mr. Vinson was a Research Associate in the Public Utility Research Center and concurrently was employed as a financial consultant in the firm of E. F. Brigham and Associates. Prior to attending the University of Florida, Mr. Vinson was a Senior Financial Analyst with Alabama Power Company.

Mr. Vinson has authored a number of articles on various financial topics, including measurement of the cost of capital, capital structure and investment risk analysis. His research interests include transitional management of firms moving from monopoly to competitive market structures, specialized financial product development for electric and gas utilities, and deregulation and privatization of public utilities. He

has served on the faculty of Georgetown University, Washington, D.C.

Mr. Vinson was born February 12, 1948, in Cullman, Alabama. He graduated from Cullman High School and in 1973 obtained the Bachelor of Science degree in accounting from the University of Alabama. Mr. Vinson is married to the former Elizabeth Whalely. They currently reside in Madison, New Jersey, with their daughter, Claire.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Eugene F. Brigham
Graduate Research Professor, Finance, Insurance, and Real Estate

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This dissertation was submitted to the Graduate Faculty of the Department of Finance, Insurance, and Real Estate in the College of Business Administration and to the Graduate School and was accepted as partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

April 1988

Dean, Graduate School